CALSIM II in California's Water Community:
Musing on a Model

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PREFACE

This research began and ends as an effort to collect thoughts from California's water community on the roles of CALSIM II in project, regional, and statewide water planning, policy, and operations. As such, this work differs from typical academic research where we researchers provide our thoughts and recommendations. Here, our purpose is to provide a fair, complete, and understandable representation of the many thoughts of many thoughtful people in California on the state's most central water resources model, CALSIM II.

Our intent is to provide the range of thoughts, so they can be judged on their own merits, not a statistical tabulation. The proportion of interviewees holding different views is not of interest here. For external model review, prioritizing model modifications, assessing potential CALSIM II applications, model training, or better understanding the modeling of such a complex and controversial water system, the relative popularity of particular thoughts at a given time is probably less insightful than the content of the range of thoughts.

The main body of the report covers the study method, interviewees, and a digest of the thoughts of 89 interviewees, with hundreds of comments in all. We apologize for missing additional individuals who could provide further insight. Summaries of every interview appear in Appendices F and G, with thoughts from these summaries organized by category in Appendix E.

We thank the CALFED Science program for funding and facilitating this work. We appreciate the cooperation of the California Department of Water Resources and US Bureau of Reclamation in providing access to their personnel and providing contact

information and scheduling help. And, of course, we are grateful for the time and insights of the 89 busy people interviewed. We have tried to capture their thoughts.

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INTRODUCTION

The purpose of this document is to collect thoughts from California's water management community on the CALSIM II computer model. These thoughts cover the range of uses for CALSIM II; perceived strengths, weaknesses, and desirable features; and more general comments on the development and use of computer models for California's complex water system. This information is anticipated to have a variety of uses for external review activities; efforts to identify, prioritize, and implement model improvements; model training; and provide general insights into water resources modeling in California's extensive and intricate inter-tied water system. More specifically these thoughts might provide information useful to the current Bulletin 160-03 California Water Plan Update Advisory Committee, CALFED, FERC re-licensing, regulatory compliance, and other relevant planning processes employing or considering CALSIM II.

CALSIM II is a model of California's State Water Project (SWP) and the Federal Central Valley Project (CVP), developed jointly by the California Department of Water Resources (DWR) and U.S. Bureau of Reclamation (USBR). While these agencies developed the model for project-related purposes, the model also has been proposed and employed for these and various other purposes. As the central official model available for the two largest inter-regional projects with implications for statewide and Central Valley water operations and planning, CALSIM II and CALSIM II results are often in the center of many technical and policy controversies. As such, CALSIM II merits and has been receiving considerable scrutiny. The range of issues raised has been diverse, but includes a variety of issues and perspectives related to water supply reliability, environmental management and performance, water demands, economics, documentation, hydrology and climate, software, and regulatory compliance.

The information presented in this document was obtained during the interviews of 89 individuals who are involved in the management, planning, decision-making, analysis, or modeling of California water resources. Information gathered during the interview process includes existing and potential uses of and questions for CALSIM II, why people select this model, their views on the strengths and weaknesses of CALSIM II and on what alternatives might exist, and what they might like to see in alternative operations and planning models. The summaries of these interviews contain hundreds of individual comments and thoughts.

This document begins with a review of the interview and write-up method, followed by a short discussion of those interviewed. Interviewee responses are then categorized and summarized in two sections, the first concerns current and potential uses of CALSIM II. The second results section categorizes and summarizes interviewee thoughts and insights on CALSIM II, covering perceived strengths and weaknesses, desirable developments, and interviewee concluding thoughts.

This report has eight appendices. Appendix A has the questionnaire used for all interviews. Appendix B contains the list of individuals that were interviewed and their affiliations. Appendix C contains a list of those individuals that were contacted but not interviewed. Appendix D is a glossary and acronym list. Appendix E contains all of the categorized comments and serves as a reference section for the Summary of Interviewees

Thoughts and Suggestions. Appendix F and G contain the written summaries of the interviews for attribution and not for attribution, respectively. Finally, Appendix H contains the citations for the references provided by interviewees.

METHOD

An interview team from the Department of Civil and Environmental Engineering, University of California at Davis conducted all interviews and write-ups. This team was overseen by Professor Jay Lund and included two doctoral students and one masters student. Interviews were conducted either in groups or individually, with at least two interviewers present for each interview (with one exception). Group sizes ranged from two to five. Whenever possible the interviews were conducted in person. When in person interviews were not possible, the interview was conducted by telephone. Interviews lasted from one half hour to two and a half hours, but were usually about an hour.

Ninety-five potential interviewees were contacted and 89 were interviewed in a total of 65 interviews from April 30 to August 28, 2003. Interviewees were identified from a broad base of agency, consulting, stakeholder, and organizational perspectives. Interviewees' names and affiliations are presented in Appendix B and Table 1.

When first contacted, potential interviewees were sent a document briefly describing the purpose of the CALSIM II interviews and the questions they would be asked during the interview (Appendix A). Notes were taken during each interview by each member of the interview team. Each interview was summarized in writing and emailed to the designated "lead interviewee," (for group interviews) who had at least two weeks to revise and extend their remarks. Each interviewee had the option to select any portion of the summary (or its entirety) to be included in remarks "not for attribution." Thus, an interviewee may have comments on CALSIM II both for attribution (personally identified) as well as "not for attribution". If an interviewee wished all comments to remain anonymous, that was also possible. However, the names of all interviewees are listed in Appendix B, except for employees of DWR and USBR, who all remain anonymous. The written summary comments of all interviewees, anonymous and for attribution, appear in Appendices F and G. Interviewees also had the option to submit separate written statements, documents, or materials for inclusion or citation in Appendix H.

Upon summary finalization, comments were aggregated into a single database (combining both "for attribution" and "not for attribution" comments) and, in the case of questions 4, 5, and 9, categorized according to content (Appendix E). Questions 1 and 8 mostly provided background information and suggestions for additional interviewees; responses for questions 1 and 6 appear in the summaries (Appendices F and G), but are not categorized and summarized in the body of the report. Responses to questions 7 and 8 are omitted entirely.

The section entitled *Current and Prospective Uses of CALSIM II* contains a summary of responses to questions 2 and 3. Answers to questions 4, 5, and 9 provide the bulk of the comments, and thus of this report. A summary of comments regarding the strengths and weaknesses of CALSIM II and suggestions on model support and development activities (questions 4, 5, and 9) can be found under *Interviewee Thoughts and Suggestions.*

In categorizing responses to questions 4, 5, and 9, our intention was to distill and present the thoughts of the 89 interviewees in a concise and readable manner. Thus, these

sections of the report contain the range of thoughts of the interviewees, and not our opinions on the topics nor our opinions on the interviewee thoughts. Notwithstanding our efforts at condensation, it is worthwhile to read the original summaries (Appendices F and G).

INTERVIEWEES

In total 89 individuals were interviewed from April to August of 2003. Interviewees encompassed individuals of both technical and policy backgrounds. Backgrounds ranged from those involved with detailed model development to model users and administrators to and a wide variety of model and model results users, many of whom never actually run the model. Thus, there is a wide range of familiarity with model details. Interviewees included DWR and USBR employees (from several divisions within these organizations), consultants, stakeholders, and organizational representatives. The list of interviewees appears in Table 1.

In addition the interviewees listed in Table 1, six other individuals were contacted, but they declined to be interviewed (see Appendix C).

Table 1: Interviewees (alphabetical order)

Name (or Number)	Affiliation
23*	California Department of Water Resources
13*	United States Bureau of Reclamation
Blair, Tim*	Metropolitan Water District of Southern California
Boardman, Tom	San Luis-Delta Mendota Water Authority
Bourez, Walter	MBK Engineers
Briggs, David	Contra Costa Water District
Brown, Paul	Camp, Dresser & McKee
Brown, Russ	Jones and Stokes
Chan, Grace	Metropolitan Water District of Southern California
Davis, Martha	Inland Empire Water District
Denton, Richard	Contra Costa Water District
Dvorak, Allison	SWRI, Inc.
Erlewine, Terry	State Water Contractors
Fock, Anna	Montgomery Watson Harza
Fryer, Lloyd	Kern County Water Authority
Fullerton, David	Metropolitan Water District of Southern California
Grinnell, Steve	Montgomery Watson Harza
Herbold, Bruce	USEPA
Hilts, Derek	USFWS
Hutton, Paul	Metropolitan Water District of Southern California
Joyce, Brian	National Heritage Institute
Kao, Cindy	Santa Clara Valley Water District
Kirby, Ken	SKS Water Management
Leaf, Rob*	CH2M-Hill
Lima, Joe*	Modesto Irrigation District
Link, Buzz	SWRI, Inc.
Maher, Joan	Santa Clara Valley Water District
Meyer, Harold	Hydrologics
Meyer, Jeff	Hydrologics
Miller, BJ	Consultant
Munevar, Armin	CH2M-Hill
O'Connor, Dennis	State Senate Agriculture and Water Committee
Orlof, Leah	Contra Costa Water District
Pahuja, Sanjay*	CH2M-Hill

Paul, Duane	Northwest Economic Associates
Purkey, David	National Heritage Institute
Quimby, Jeff	Contra Costa Water District
Rosekrans, Spreck	Environmental Defense Fund
Satkowski, Richard	State Water Resources Control Board
Schuster, Dave*	SWRI, Inc.
Sheer, Dan	Hydrologics
Shum, KT	East Bay Municipal Utility District
Smith, Bill	SWRI, Inc.
Snow, Jim	Westlands Water District
Spivy-Weber, Frances	Mono Lake Committee
Steiner, Dan	Consultant
Sun, Yung-Hsin	Montgomery Watson Harza
Tull, Rob	CH2M-Hill
Tustisen, Ben	MBK Engineers
Upadhyay, Deven	Metropolitan Water District of Southern California
Van Lienden, Brian	SKS Water Management
Vorster, Peter	Bay Institute
Wang, Chuching	Metropolitan Water District of Southern California
Wilkinson, Robert	UCSB
Williamson, Mark	SKS Water Management

* Comments were "Not For Attribution"

CURRENT AND PROSPECTIVE USES OF CALSIM II

Current uses of CALSIM II are wide-ranging. These include planning studies, operations, facility planning, regulatory compliance, development, management, impact estimation, and policy evaluation purposes. Interviewees commonly, even typically, mention interaction with other models as a common use of CALSIM II, as its output serves as input to numerous economic, hydrodynamic, water quality, operations, and other water planning models at both state and local levels. The current and prospective uses of CALSIM II mentioned by interviewees are presented below and summarized in Table 2.

I. PLANNING STUDIES

Many interviewees currently use CALSIM II for long-term planning. Some of these individuals are involved in statewide planning efforts that rely on CALSIM II to analyze various "what if" scenarios for the future. Others are involved in strategic planning such as Bulletin 160 and would like to see those analyses use CALSIM II or are concerned about using CALSIM II for such applications. Others use the model for integrated water resources plans at the district level as part of efforts to assess the availability of water supplies over the long term. Results of these planning studies may inform decisions regarding investment in alternative management options such as conservation, recycling, and the purchase of options. Some districts rely on CALSIM II results to guide their long-term plans indirectly through their use in the recent SWP Reliability Report or similar studies based on CALSIM II model runs. Others use CALSIM II to assess likely allocations to water contractors. Other current and prospective planning uses include using CALSIM II to evaluate the effects of climate change and changes in land-use on the statewide system.

Several interviewees would like to use CALSIM II to perform climate change studies in the future. Most anticipate continuing current uses for planning, with additional future interest in using CALSIM II to generate water deliveries estimates and represent water rights.

II. PROPOSED FACILITIES

A primary use of CALSIM II is to estimate the impacts and benefits proposed projects and regulatory actions would have on the statewide system. Current analyses focus on proposed CALFED storage projects, including In-Delta storage, North of Delta Offstream Storage (Sites Reservoir), expansion of Los Vaqueros and Shasta reservoirs, storage in the Upper San Joaquin Basin, and conjunctive use north and south of the Delta.

CALSIM II is also being used to evaluate CALFED conveyance projects such as the proposed expansion of the Banks Pumping Plant to 8,500 cubic feet per second (and possibly 10,300 cfs). Still others study the California Aqueduct/ Delta-Mendota Canal Intertie, and the San Luis Reservoir Low Point Improvement Project.

Many local agencies use CALSIM II results to estimate impacts to their agencies of proposed actions and projects including CALFED actions, regulatory scenarios, and operational strategies. These uses are anticipated to continue in the future.

Table 2. Current and Prospective Uses of CALSIM II, with Examples.

Use	Current*	Prospective
Planning Studies		
California Water Plan Update	x	x
SWP Reliability Study	x	x
Integrated Water Resources Planning (local)	x	x
Climate Change		x
Water Rights		x
Proposed Facilities		
CALFED Storage Projects	x	x
CALFED Conveyance Projects	x	x
Dam removal		x
Bay-Delta projects	x	x
Delta diversions	x	x
Operations		
CVP OCAP	x	
SWP	x	x
Coordinated Operations Agreement	x	
Stanislaus River Interim Operations Plan	x	
Water temperature management	x	x
Seasonal Planning (local) operations	x	x
Real-time		x
Position analysis	x	x
Risk assessment		x
Development of improved Delta operation rules		x
Project water allocation decisions with optimization		x
Operational planning of energy production	x	x
Water quality forecast		x
Conjunctive use and groundwater banking	x	x
Regulatory Analysis and Compliance		
FERC re-licensing	x	x
American River Revised Flow Standards	x	
Water rights		x
SWRCB Delta water quality standards		x
EIR/EIS	x	x
CVPIA (e.g., (b)(2))	x	x
EWA	x	x
ESA consultations	x	x
Restrictions on Delta exports	x	x
Evaluation of Management Options		
Water transfers	x	x
Water conservation	x	x
Conjunctive use of surface water and groundwater	x	x
Groundwater banking	x	x
Water recycling		x
Desalination		x
Other		
Gaming Exercises	x	x
Development of legal strategies	x	x
Hydropower generation	x	x
Fluvial process restoration		x

* Includes use of CALSIM II as part of larger analysis, often with other models.

Additional current and prospective uses of CALSIM II include the review of environmental standards effectiveness, changes in land-use, export restrictions, and water demand levels. Other potential CALSIM II uses are the evaluation of recirculation of the San Joaquin River water at the Delta or points upstream, impact analysis of removal of O'Shaughnessy Dam, and to generate boundary conditions for Delta models for impact analyses of proposed changes in hydrology, operations, or hydraulic control structures in the Delta. Other uses of CALSIM II include the evaluation of the effects of Bay-Delta projects on water quality and supply, and effects of different Delta diversions on fish populations.

Anticipated future uses of CALSIM II focus similar analyses and on the same CALFED projects, including calculating their impacts and benefits. Many interviewees suggest that CALSIM II will be used to investigate any proposed projects that come up in the future.

III. OPERATIONS

Many interviewees currently use CALSIM II to assess effects of operational changes on the statewide system and to help plan local and regional operations. Several agencies use CALSIM II or its results for seasonal operations planning, or planning operations for the coming year or even month. None use CALSIM II as their sole real-time operations model. Instead, they frequently use outputs from CALSIM II as an input to local or regional operations and operations planning models. These operations uses are undertaken despite concerns about the absolute or predictive nature of such applications.

Current operations uses of CALSIM II include review of CVP Operations Criteria and Plan (OCAP), Coordinated Operation Agreement (COA) analysis, Stanislaus River Interim Operations Plan, water temperature management, and identification of potential improvements in water operations. CALSIM II is also used for Monte Carlo analysis at the beginning of each year to estimate the likelihood of filling reservoirs during the water year.

While a significant number of interviewees indicate their agencies use CALSIM II for seasonal planning, most agree in principle that the model is not appropriate for short-term and real time operations planning as it is currently configured. Other interviewees specify that they use CALSIM II only for long-term planning, and rely on spreadsheet models for planning at the seasonal or shorter time scale.

Many interviewees expressed interest in using CALSIM II for real-time and position analyses in the future. Further developments to the model are desirable or necessary for these uses, but would allow CALSIM II to replace spreadsheet models currently used for these purposes. In addition, several interviewees would like to use CALSIM II to assess risks associated with operating the system more aggressively and trying to run it efficiently. A few interviewees stated that CALSIM II should be flexible enough to test and improve operating rules and guidelines. Another future of use of CALSIM II is to help make project allocation decisions using a multi-period optimization module based on forecasted inflows. One interviewee would like to use CALSIM II in the development of improved Delta operations rules.

Also mentioned is the application of CALSIM II is the validation of short-term models to ensure that DWR does not over- or under-commit to contractors. To do this, CALSIM II would have to use forecast based on snow surveys, as is done in real-time operations. Additional potential applications of CALSIM II include operational planning of energy production to better plan energy market strategy and water quality forecasts and analyses of conjunctive use and groundwater banking.

IV. Regulatory Analyses and Compliance

Interviewees use CALSIM II for many of the analyses required by state and federal regulations, including consultations under the federal Endangered Species Act (ESA), re-licensing of Oroville Dam by the Federal Energy Regulatory Commission (FERC), and revised flow standards for the American River under the authority of the State Water Resources Control Board (SWRCB). SWRCB also uses CALSIM II results for licensing and permitting. Several respondents also anticipate using CALSIM II regarding water quality standards, specifically the SWRCB's upcoming triennial review of water quality standards in the Delta. Additional regulations that interviewees indicate require CALSIM II results include those under the National Environmental Protection Act (NEPA) and California Environmental Quality Act (CEQA), the Central Valley Improvement Act (CVPIA), and restrictions on Delta exports. Some interviewees suggest that they may use CALSIM II for future analyses of water supplies that could be required by regulations for proposed changes in land use.

Several interviewees currently use CALSIM II for Environmental Impact Reports and Statements (EIRs and EISs). In addition to the CALFED projects, current EIR/EIS analyses that use CALSIM II include, Environmental Water Account (EWA), Monterey Agreement, Trinity River, Freeport Regional Water Project, Phase 8 Process, and other projects located both north and south of the Delta. Interviewees foresee applying CALSIM II to similar analyses for proposed projects in the future.

V. Evaluation of Management Options

A few interviewees currently use CALSIM II to support management activities such as water transfers, conservation, groundwater banking, recycling, desalination, conjunctive use, and the purchase of options. A greater number of additional interviewees indicated their expectation to use CALSIM II for the analyses of these and other management options in the future. A few interviewees stressed the importance of being able to obtain accurate predictions of project deliveries, as those predictions are used to make financial decisions of considerable magnitude.

VI. Other Uses of CALSIM II

Many interviewees suggested the use of CALSIM II for purposes other than those described above. A few interviewees cited the use of CALSIM II to develop legal strategy, while others use CALSIM II outputs in various gaming exercises. Other interviewees post-process CALSIM II output to evaluate opportunities of moving CVP water through Banks Pumping Plant, and hydropower generation, and Western Area Power Authority marketing plan. One interviewee would like to use CALSIM II to

conduct studies of fluvial process restoration, something that requires a smaller time step than currently used in CALSIM II.

VII. USE OF CALSIM II WITH OTHER MODELS

Many interviewees currently use CALSIM II in conjunction with a variety of other models (Table 3). The vast majority of these use CALSIM II output as input to other models, often DSM2 or other hydrodynamic models of the Delta. Others use CALSIM II output as input for CALAG, CVGSM, or CVPM, which model water movement and agricultural production. Many local and regional models, including MWD's IRPSIM and SCVWD's SYSMOD also use CALSIM II output as input to their analyses. Water temperature and water quality models also frequently use CALSIM II results as input. Interviewees anticipate using CALSIM II results as input to the same or similar models in the future. They also express interest in using CALSIM II output as input to economic, groundwater, and hydropower models.

A few interviewees also run models to generate input to CALSIM II, including the Consumptive Use Model, and LCPSIM to provide time series of Article 21 demands.

Table 3. Other Models used with CALSIM II, with Examples.

CALSIM II Provides Input For:
Local Operations, Planning, and Distribution Models
IRPSIM, IRPDSM (MWD)
SYSMOD (SCVWD)
KCWA model
Economic Models
CVPM
CALAG
Delta Hydrodynamic Models
DSM2
FDM
Groundwater Models
CVGSM
Provides Input to CALSIM II:
Hydrology Models
Consumptive Use Model
CVGSM
Water Demand Models
LCPSIM

INTERVIEWEE THOUGHTS AND SUGGESTIONS

Most interviewee comments relate to interviewees' thoughts on CALSIM II strengths and weaknesses (question 4), suggestions on CALSIM II support and development (question 5), and concluding thoughts (question 9). Interviewee thoughts and suggestions were classified according to five major categories and 31 sub-categories as listed below (Table 2). In some cases individual comments were duplicated in more than one category. Comments directly from interviewee summaries are organized by these categories and presented in Appendix E.

Table 3. Categorization of Thoughts and Suggestions.

Major Category	Sub-Category
I. Mission	A. General Comments B. Uses of the Model C. Model Scope D. Consensus Model E. Comparative vs. Absolute Applications F. Geographic Scope and Scale G. Other
II. Administration	A. Support B. Documentation C. Management of Model Development D. Credibility E. Revisions and Updates F. Calibration G. Benchmark Study
III. Implementation	A. Mathematical Formulation B. Operations Representation C. Model Complexity D. Time step E. Model Flexibility F. Representation of Management Options G. Stability/Sensitivity of Model Results H. Geographic Representation I. Run Time J. Other
IV. Inputs	A. General Comments B. Demands C. Hydrology
V. Software	A. Solver B. GUI (Graphical User Interface) C. Output/Post-processor D. Database/Data Management Software E. DSS (Data Storage System) F. WRESL (Water Resources Simulation Language) G. Transparency H. Simulation vs. Optimization I. Other

I. MISSION

Prior to development of a model, developers commonly have purposes or uses in mind. Purpose(s) can range from very specific to very general. Many of the comments on CALSIM II relate to various aspects of the model's mission(s). Agency, stakeholders, consultants, and organizational representatives have a variety of **uses of CALSIM II**, including both technical and policy applications. Many interviewees regard CALSIM II as a **consensus model** because it is jointly developed and supported by DWR and USBR. Among the concerns interviewees have with CALSIM II are the **model's scope**, **comparative versus absolute** (or predictive) capabilities and the **geographic scope and scale** included in the model.

A. General Comments

CALSIM II is a large model, encompassing much of California's integrated water system. Interviewees have comments and concerns regarding perceived strengths and weaknesses in CALSIM II, its role in water management, and how it was formulated.

Interviewee Thoughts and Suggestions

1. *CALSIM II is an adequate/inadequate statewide model.* California's water landscape has become increasingly complex in recent decades. As a result, interviewees indicate a greater need for a system-wide model that can help water managers assess the impacts that operations would have not only on their regions, but other regions as well. Some feel that CALSIM II is a good tool for modeling system-wide "what-if" type questions. However, others feel that there is still a need to model additional alternatives to encompass a wider range of possible operations.

2. *CALSIM II tries to do too much.* Several interviewees feel that CALSIM II tries to pull together too many detailed processes into a single model. Some interviewees feel that it would be better to have multiple separate (but detailed) models for policy analysis, perhaps on a regional or watershed scale. As it is, some interviewees feel that CALSIM II does not adequately forecast operations. Likewise it has difficulties when applied to regulatory or policy analysis. Some interviewees would like DWR and USBR to design two (or three) models to run in parallel, rather than have one large model. Some interviewees recommend two complementary models, one strategic (predictive) and the other tactical (comparative). Other interviewees feel that there should be two versions of CALSIM II: a high-end version of CALSIM II capable of doing detailed analysis and a low-end version capable of making quick, gross analyses.

3. *The questions that CALSIM II is designed to answer were not clearly thought out before the model was built*. CALSIM II was designed based on DWRSIM and PROSIM and incorporated much of their logic and data. For any model, the developers should think about the questions and applications that the model will be used for before construction. Some interviewees feel that DWR and USBR did not think through the questions that would be asked of the model prior to development. As a result, CALSIM II is incapable of answering many of the questions for which interviewees need answers.

4. *Some interviewees see CALSIM II as the only tool available.* Some interviewees consider CALSIM II to be the only available modeling tool that can be used for the CVP/SWP systems. The limited (or seemingly limited) options in available tools for California water mangers leads to the perception that CALSIM II is often misused, misapplied, or over-stretched. Likewise, some interviewees feel that the agencies have already invested too much time and money into CALSIM II to be able to objectively ask if the model can answer the questions asked of it and if not then what can and/or should be done.

5. *CALSIM II needs a peer review*. CALSIM II needs to be reviewed by a panel of experts that do not have any vested interested in the model. This panel should be composed of a variety of experts within the field of water resources planning and management models. They should look at CALSIM II and see if the model can answer two questions: can it answer the questions that interviewees are asking of it and is it calibrated to make it a useful model.

B. Uses of the Model

There is a wide range of applications to which CALSIM II can be applied. Interviewees have comments regarding the expectations, appropriate applications, and needs for CALSIM II.

Interviewee Thoughts and Suggestions

1. *There is a huge range of expectations regarding CALSIM II.* There is a perception that prior to creating CALSIM II, neither DWR nor USBR surveyed the water community regarding what questions the community would want the model to be capable of answering. As a result, there is no defined set of expectations. Rather, interviewees all have different ideas regarding which questions CALSIM II can answer, resulting in a wide range of expectations.

2. *It is difficult to determine what applications are appropriate for CALSIM II*. There is a lack of experts (both in agencies and among consultants) that can aide interviewees in assessing if CALSIM II is appropriate for a study. For example, according to one user, CALSIM II is incapable of assessing impacts to fisheries in the Delta adequately, but that is not preventing application of CALSIM II for fisheries impact studies.

3. *Proper application of CALSIM II could improve its credibility.* CALSIM II is a comparative model, but it is being used for a variety of purposes, including some for which it is not well suited. One interviewee stated that misapplication of CALSIM II undermines the model's credibility making it appear weak when it may not be. CALSIM II is a technical tool designed to aid in making decisions regarding the CVP and SWP. However, CALSIM II cannot address all issues involved in water policy because of the overwhelming data and analysis requirements both due to the model structure (i.e., input requirements) and scope of the policy questions. Additionally, CALSIM II's credibility suffers when it is used as a political tool, rather than as a technical support tool.

4. *CALSIM II needs implementation protocols and periodic testing*. Some interviewees feel that DWR and USBR need to write implementation protocols to

help model users appropriately implement CALSIM II. Additionally, periodic testing of CALSIM II needs to be done to ensure the model's accuracy.

5. *CALSIM II could be used to reduce uncertainty in the system.* Interviewees acknowledge that results from CALSIM II runs do not guarantee the system will behave in the manner predicted. According to one interviewee, CALSIM II's ability to represent physical processes is limited by relatively weak understanding of water quality and groundwater processes and the behavior of the California water system. However, if applied correctly, CALSIM II could be used to reduce (but not eliminate) uncertainty in how operational and regulatory changes would affect the system.

6. *California Water Plan Update, Bulletin 160 should use CALSIM II cautiously.* CALSIM II should be used, but with caution, for the Bulletin 160 process. As DWR (and USBR) continue to develop and refine CALSIM II they should be aware of the needs of Bulletin 160. Likewise, as Bulletin 160 considers using CALSIM II as the basis for its modeling efforts, the limitations of CALSIM II should be kept in mind.

7. *CALSIM II is a good/poor learning tool.* Some interviewees state that CALSIM II is a good tool for learning about the state's water projects, while others disagree.

C. Model Scope

DWR and USBR are in the process of updating, revising, and refining CALSIM II. Interviewees have several suggestions for development activities, including a range of regulatory and physical processes and water management options that should be included in future releases of CALSIM II.

Interviewee Thoughts and Suggestions

1. *Continued development of CALSIM II is needed*. CALSIM II needs continual development and refinement. One interviewee feels that the developers need to talk with model users and determine what improvements and additions are wanted. Among those interviewed, there were concerns regarding how regulatory requirements, especially those concerning biological processes (such as fisheries and the Delta), are represented. Other interviewees think improvements should be made to how water quality, hydrodynamics, and hydropower accounting are represented. Some interviewees would like the linkage between groundwater and surface water to be improved, so that in the future CALSIM II could be tied to CVGSM. Other interviewees want CALSIM II to be able to model varying levels of development, rather than be limited to a static level of development. Another interviewee stated that CALSIM II could be more useful if it were able to model varying/seasonal demands.

2. *CALSIM II needs to be capable of modeling future hydrologic scenarios.* CALSIM II is able to simulate the CVP/SWP systems over the 72-year historical hydrology, which theoretically allows model users to assess the effects that re-operation would have had on the system. However, some interviewees are concerned that the past hydrology may not be a good indicator of the future. They

state that model users cannot or should not assume that the past hydrology is a good predictor of future hydrology. In recent decades, concerns regarding global warming have risen considerably. While there is still debate regarding the specific impacts it will have on water availability in California, several interviewees indicate that water managers should begin to consider global climate change when planning for the future and that at present, CALSIM II is not suited to model perturbed hydrology or other future scenarios.

3. *CALSIM II does not include economics*. CALSIM II is a simulation model and does not use economics, resulting in static demands. Implementation of economic features into CALSIM II would enable model users to better model non-static demands. Several interviewees feel that DWR and USBR should include economics into future versions of CALSIM II if possible, or in a new model if one is created.

4. *CALSIM II needs better modeling of water quality issues.* Many interviewees express the need for better modeling of water quality in CALSIM II. One interviewee states that a better coupling between CALSIM II and water quality models is needed.

5. *CALSIM II should include energy costs*.

6. *CALSIM II needs to incorporate water temperature requirements and hydropower objectives*.

7. *CALSIM II needs to include water rights explicitly.* One interviewee indicates that it would be useful if CALSIM II had capability to quantitatively represent water rights for the system.

8. *CALSIM II needs to be linked to the gaming exercises.*

D. Consensus Model

Prior to CALSIM II, DWR and USBR had independent models of the Central Valley projects (DWRSIM and PROSIM, respectively). The two models had different sets of hydrology and treated project operations differently.

Interviewee Thoughts and Suggestions

1. *CALSIM II is a standard modeling tool for both state and federal agencies*. CALSIM II reflects the reality that the state's two largest water projects are not independent systems. To that end, CALSIM II includes both the SWP and CVP systems, allowing modelers to analyze the effects of various activities on the operations of both major water projects simultaneously. There is agreement among interviewees that having a single model for both projects (and the support of both agencies) has improved consistency among study results and improved model development productivity. However, there is some concern that without competing models between DWR and USBR some of the checks and balances in the modeling process will be lost. Conversely, some interviewees feel it is easier to scrutinize one model, rather than two.

2. *Having a common model has resulted in DWR and USBR agreeing on a single (joint) data set.* By agreeing to use the same model, DWR and USBR have

agreed agree upon a common hydrology. The hydrology for DWRSIM and PROSIM can differ considerably creating difficulties in comparing results. The "joint hydrology" eliminates one source of conflict between DWR and USBR's modeling efforts.

3. *Agency cooperation has improved and grown with the development of CALSIM II.* Many interviewees feel that working together on CALSIM II has increased cooperation between the modeling sections in DWR and USBR. Prior to CALSIM II the two sections were in contact less, as each agency had its own model. The two agencies now work together to maintain, develop, and enhance CALSIM II. While generally viewed as positive, there is a perception that DWR is more involved with CALSIM II development than USBR, leading some to feel that the representation of the SWP has been refined to a greater extent than that of the CVP.

4. *Having a common modeling tool is a strength*. Several interviewees asserted that by agreeing upon a single model for current and future studies, USBR and DWR have shifted the focus of discussions from disagreements over modeling methods and formulations to discussions regarding result interpretations.

E. Comparative vs. Absolute Applications

Comparative modeling examines differences between multiple model runs to evaluate the effects that varying a condition will have on the system. Absolute (or predictive) modeling directly estimates what will happen to the system given a single set of inputs.

Interviewee Thoughts and Suggestions

1. *CALSIM II is a comparative model, ill suited to predictive (absolute) applications*. DWR and USBR describe CALSIM II as a comparative model, well suited for long-term comparative "what-if" type studies. Interviewees often indicate that the questions being asked of CALSIM II have shifted. In the past CALSIM II was used to compare the relative performances of alternatives, but recent applications focus more on the absolute quantities. Many interviewees acknowledge that using CALSIM II in a predictive manner is risky and/or inappropriate, but without any other agency-supported alternative they have no other option. To that end, interviewees often want DWR and USBR to either improve CALSIM II's predictive capabilities or create a predictive companion model.

2. *There is a lack of CALSIM II documentation for predictive studies*. CALSIM II lacks detailed documentation regarding the known limitations and weakness of the model. Without a clear understanding of the model's formulation, interviewees are wary of applying it in a predictive (absolute) mode. If it is to be used in a predictive manner one interviewee feels that the likely error bars need to be specified. Despite the concerns, some stakeholders are already using CALSIM II in a predictive mode.

3. *Identification of system biases is less of a concern in long term planning studies, but becomes more critical in short-term operations studies*. Many interviewees view CALSIM II as being well suited for long-term comparative studies, but

considerably less applicable for short-term operations studies. In comparative studies, model limitations and weaknesses are less of an issue because all model runs contain the same system bias. The relative differences between the modeling alternatives are of greater importance than the actual numerical values. However, short-term studies commonly require using CALSIM II in a predictive (absolute) mode, where the actual numerical values are important. In this mode, model limitations and weakness are more likely to skew results and less likely to be identified.

4. *Calibration and validation are weak*. Some interviewees view calibration and validation of CALSIM II as either weak on non-existent. Without calibration of the model it is difficult for interviewees to identify the weaknesses (or strengths) of CALSIM II for uses in predictive studies. There is considerable call by the modeling community for DWR and USBR to perform the calibration and validation and issue a benchmark study. Some other interviewees believe that calibration of CALSIM II is either adequate or unnecessary for this type of model.

F. Geographic Scope and Scale

Geographic scope and scale refers to the local, regional, and statewide systems that CALSIM II currently represents.

Interviewee Thoughts and Suggestions

1. *CALSIM II is an adequate/inadequate model of the CVP/SWP system*. CALSIM II is the only agency supported model of the CVP/SWP system. Interviewees frequently feel that DWR and USBR have a relatively good model of their projects. However, some interviewees feel that CALSIM II should only be used to analyze the effects of the CVP/SWP system because CALSIM II does not represent other features of the state to the same level of detail that it does the two major projects. There is also some concern that the CALSIM II represents the SWP better than the CVP. Additionally, one interviewee feels that system efficiency is reduced because water managers cannot predict joint operations and hopes that in the future CALSIM II will be able to do so.

2. *CALSIM II has the largest geographic scope of the agency-supported models.* CALSIM II has received some praise for having the most extensive coverage of the state's major water projects, although it does not completely represent the state's water system. CALSIM II was based primarily on DWR's DWRSIM and USBR's PROSIM models and there is the belief that it has inherited some of the previous models' weaknesses in that it focuses too much on the projects and excludes many other important features of California's water landscape.

3. *Additional geographic coverage and management options are needed in CALSIM II*. The focus on the SWP and CVP system limits is usefulness. There is a call for improved and added representation of many areas within California. Until such time as critical regions are added, interviewees feel that CALSIM II is not truly an adequate statewide model. Among the regions specifically mentioned were the Tulare Basin (including the Friant-Kern and Madera Canals, East Side San Joaquin Reservoirs and Millerton), Yuba River Basin (for potential water transfer

opportunities), Bay Area, Colorado River, Colorado River and Los Angles aqueducts and local Southern California projects. Also, interviewees mention that groundwater banking, conjunctive use, desalination, recycling, and conservation options are represented inadequately. Interviewees have requested that these areas and options be added to subsequent versions of CALSIM II. Some feel that without representing these options, facilities and regions CALSIM II is unable to adequately model the range of water operations available to the state.

4. *CALSIM II needs a finer geographic resolution.* While interviewees agree that CALSIM II has the largest geographic scope of any agency-supported model, there is still a call for a finer geographic resolution. Some interviewees want the ability to do regional and local or watershed level studies with CALSIM II.

G. Other

Other comments address general thoughts regarding CALSIM II, modeling, and DWR's role in the water community

Interviewee Thoughts and Suggestions

1. *CALSIM II is publicly available, making it easily accessible.*
2. *Litigation has lead to a better understanding of CALSIM II and the critical model parameters.*
3. *If CALSIM II were easier to understand, the legislature might provide more funding.*
4. *One interviewee feels that there is a poor understanding of California water (groundwater, water quality, etc.).*
5. *"The concept of CALSIM II is right and very similar to OASIS."*
6. *DWR's modeling efforts have put California ahead of other states in terms of development of analysis tools.* One interviewee commented that DWR's modeling efforts have been beneficial to California. However, another interviewee feels that DWR's should have spent more time determining the operating rules and by putting more emphasis on finding allocations that increase "beneficial uses" opposed to simulating the current system.
7. *DWR should act as a data clearinghouse.* Water resource planning and management responsibilities are shifting from the state to more of the local regions. As a result, DWR's role in water planning is changing. They should facilitate data sharing and management among the regional planning agencies.

Modeling is often seen as a stall tactic. Interviewees feel that there is a perception within the policy community that suggesting modeling or technical analysis is a means of stalling a discussion.

II. ADMINISTRATION

Administration describes how DWR and USBR manage, direct, and supervise CALSIM II and related activities. These activities include their efforts to provide **support** to model users and **documentation** of the model and its inputs, their general **management**

of model development, and the **credibility** that the model has with its users and the larger community of water managers. Feedback regarding **revisions and updates** to CALSIM II, efforts to **calibrate** the model, and the **benchmark** study are also addressed.

A. Support

Comments address existing and desired forms of support provided to CALSIM II users by DWR and USBR. They focus on existing training courses and potential additional services such as a help desk for CALSIM II users, user groups, or a pool of experienced CALSIM II users whose knowledge can be tapped to educate others.

Interviewee Thoughts and Suggestions

1. *There is a need for more people who can run CALSIM II*. The current need for model runs outstrips the number of people who can produce them, and this situation is likely to worsen as demand for CALSIM II runs continues to grow. CALSIM II is extremely complex, requiring significant knowledge to set up, conduct, and understand the results of a model run. This complexity is daunting to new and potential users. As a result, there are very few individuals who can conduct this entire process and produce "good" CALSIM II runs.

   This shortage has a variety of consequences. First, it means that DWR and USBR may not be able to produce CALSIM II runs quickly for those who request them. This may reduce the usefulness of the model, if it is effectively inaccessible due to the bottleneck caused by a lack of qualified modelers. There is already a backlog of studies waiting for CALSIM II runs, and some interviewees state that they have had to make management decisions in less time than it takes for DWR and USBR to produce a CALSIM II run. Second, the narrow circle of knowledgeable CALSIM II users contributes to the perception that CALSIM II is a "closed shop" available only to a few insiders. This perception also raises concerns about conflicts of interest, as skills on which many diverse stakeholders rely are concentrated in the hands of a few consulting firms and DWR and USBR. Finally, a limited group of users limits the power of CALSIM II as an analytical tool. Some interviewees see CALSIM II's power and utility as a function of its use by a broad spectrum of groups representing different facets of water management debates. They feel that a broader user group will lead to broader acceptance of CALSIM II and its results. Others suggest that a broader knowledge base regarding CALSIM II would have the additional advantage of providing greater competition for contracts to conduct analyses. Interviewees agree that DWR and USBR should actively seek to expand this group of expert users, including to non-agency and non-consulting users.

   In addition to the general desire for a broader range of individuals who can run CALSIM II, there currently is concern that CALSIM II analyses are considered "good" or "acceptable" only with the approval of a select group of individuals who are very familiar with the model and the system. A larger pool of users is likely to broaden this circle and dilute the influence of individuals. In the absence of broadening this group, or until the number of qualified users has increased

sufficiently, there may be some value in creating a standing review group or some other relatively objective method to certify studies.

2. *DWR and USBR have not provided a centralized source of support for CALSIM II*. When individuals, especially those outside of DWR and USBR and their consulting firms, have questions, there is no clear channel through which to contact DWR and USBR. Many interviewees express interest in a help desk for CALSIM II. Specific functions performed by the help desk would include providing guidance regarding model code, logic, and structure and information on assumptions made in the model, among others. The issue of a help desk is of particular interest to users who are not affiliated with DWR, USBR, or their major consultants, as these users feel that the lack of support stifles their understanding and use of CALSIM II, making it even more difficult to expand the circle of existing users. Some interviewees indicate that detailed knowledge of CALSIM II has become almost proprietary knowledge for a few consulting firms, actively discouraging the exchange of information and assistance. Users who do receive solid support of their uses of CALSIM II indicate that that support is key to their positive impression of the model.

   Several interviewees suggest that an effective website could serve many of the desired functions for disseminating information about CALSIM II. Suggestions include online tutorials for running CALSIM II and interpreting its results, utilities with which to download data and perform statistical analyses of results, answers to common questions, and results from a sample CALSIM II run.

3. *Existing efforts to provide training for CALSIM II have been admirable, but more is needed*. Many interviewees express appreciation for DWR and USBR' efforts to provide training courses for CALSIM II. Many also indicate that providing such training is not the primary purpose of DWR and USBR and that providing the level of support necessary for all CALSIM II users would be challenging for DWR and USBR at best, and more likely, unrealistic. Interviewees indicate that the existing two-day training courses that focus on how to run CALSIM II do not provide enough information to teach people how to run CALSIM II properly and understand its results. Non-agency, non-consulting parties such as water contractors, water districts, and advocacy groups would like to develop the skills to run CALSIM II on their own but need the educational support. It is important that instruction addresses both the logistics of running CALSIM II and the subtleties required to understand the meaning of its output and how it should or should not be applied.

   In addition to augmenting existing technical training courses, interviewees express interest in workshops or other educational efforts directed at increasing non-technical individuals' understanding of CALSIM II. One potential audience for such an event might be legislative staffers. There is general agreement that making CALSIM II accessible and understandable to more people is beneficial and will require some additional outreach effort on the part of DWR and USBR.

4. *CALSIM II needs a well-publicized user group*. The existing informal user group is helpful, but many people are unaware of or do not have access to it. The

formation of a formal user group would be a big step toward educating and supporting a broader base of CALSIM II users. It also would help to dispel the image of CALSIM II as a "closed shop" and would provide information to users outside DWR and USBR without using too many agency resources. Some interviewees also suggest that such a group could serve as a forum with which to collect input from the entire CALSIM II user community on aspects of the model that need improvement and further development. They hope that model developers would be open and responsive to input from such a group and see value in broadening access to the development process. In addition, one interviewee suggests that a user group should review CALSIM II's input data and make recommendations regarding areas that are particularly weak and in need of attention.

The user group could be as formal as having regularly scheduled meetings or as informal as an email list to which to post questions. Some interviewees express a preference for having an entity other than DWR or USBR administer the user group; the California Water and Environmental Modeling Forum is recommended as one possible moderator. Other interviewees express a preference for a group run by DWR and USBR, while still others want a group specifically for agency staff. Various interviewees are interested in a user group geared both toward beginners and more advanced technical users. Some feel that experienced CALSIM II users need to be involved in any user group so that there is someone available to provide answers for and/or assist in addressing problems raised regarding the model.

B. Documentation

Interviewees critique documentation of the CALSIM model and the data, inputs, and results associated with CALSIM II. Comments also address the need for better instructions on how to run the model (e.g., a better manual), information and guidance on limitations of CALSIM II, and questions regarding the difficulty of duplicating a model run.

Interviewee Thoughts and Suggestions

1. *CALSIM II requires many input files, not all of which have documentation.* Especially because CALSIM II is data-driven and requires extensive input data, it is important that input files include documentation so that users can understand their contents and potential assumptions. There are too many files to keep track of without an organized effort to document all input data. Some files have such documentation, and efforts should be made to expand this to all input files.

2. *The assumptions built in to CALSIM II are documented poorly.* To the extent that assumptions are documented, it is at a very technical, specific level, without explanation of how they relate to broad-level assumptions. This makes it difficult for anyone except technical staff who run CALSIM II to understand how a given model run arrives at its results. Some assumptions are completely undocumented and unexplained, even when those assumptions have significant effects on model results. Overall, the lack of clear and comprehensible documentation increases the likelihood of misunderstandings regarding how the model functions and it

contributes to the general impression of CALSIM II as a "black box" whose inner workings are beyond the comprehension of most users. This also makes CALSIM II runs difficult to duplicate, potentially eroding the model's credibility.

3. *There is insufficient documentation of the conceptual model, its methodology, and its logic.* Interviewees agree that existing documentation of the CALSIM II model is insufficient. They also express strong support for DWR and USBR' current efforts to improve and expand documentation, indicating that this is necessary if CALSIM II is to be transparent, accessible, understood, and ultimately accepted by the larger modeling and policy community. Concerns include that current documentation is inconsistent across different portions of the model and is not clear. It takes a long time for users to answer seemingly trivial questions, and it is difficult for new users to learn how to use the model at all. Some believe that documentation for CALSIM II exists primarily in the heads of its developers.

   Many interviewees express concern that individual parameters lack the documentation necessary to explain their origins and/or meaning. For example, some output values are poorly explained, which can lead to misuse and misunderstanding of results. Interviewees specifically identified Delta surplus outflow as mislabeled (i.e., the value labeled Delta surplus does not actually represent Delta surplus outflow; actual Delta surplus outflow must be calculated from other output values during post-processing). General consensus indicates that CALSIM II is sufficiently complex that users at all levels need guidance to understand its many functions and how they connect to each other. Clear and comprehensive documentation of CALSIM II, its values, and their origins should be a high priority for DWR and USBR.

4. *CALSIM II creators have not provided enough information on the limitations of the model*. CALSIM II is still relatively new and many users are unsure of and thus uncomfortable with its limitations. The fact that CALSIM II is priority-based rather than rule-based adds to this uncertainty, since the model's structure and logic differ significantly from previous models (e.g., DWRSIM and PROSIM). Interviewees express concern that users are not well versed in the appropriate range of applications for CALSIM II or in the interpretation of its results. Many indicate that such an understanding is essential to produce meaningful analyses. Interviewees would like to see a concerted effort by DWR and USBR to document CALSIM II's limitations, including a clear description of what the model does and does not do well. Such documentation is essential in the larger effort to build understanding of and confidence in CALSIM II and its results.

   In addition, one interviewee sees the need for more discussion between CALSIM II developers and users regarding the derivation of inputs to CALSIM II and the use of its outputs. CALSIM II is used in conjunction with many other models, all of which would benefit from a discussion of limitations of each individual model and how these limitations affect the other models.

5. *No information is available regarding uncertainties associated with CALSIM II results*. CALSIM II output does not include any form of sensitivity or error analysis. Interviewees indicate that information on the uncertainty associated with CALSIM II results in the form of error bounds, ranges for individual values, or statistical parameters (e.g., mean, variance, etc.) would further inform users regarding the limitations of specific outputs. Interviewees were particularly concerned with the need for more information on uncertainties if CALSIM II is used in "absolute" mode, rather than for comparative analysis.

6. *A more extensive users' guide is needed*. Interviewees indicate that the existing users' guide helps individuals to learn how to use CALSIM II, but should be expanded and improved. Specifically, some would like more written guidance regarding application of the model, in addition to running it. Others simply would like a more comprehensive and thorough manual for CALSIM II. Any such manual should be available online.

C. Management of Model Development

Comments in this area address DWR and USBR' handling of the development, dispersal, and application of CALSIM II. They include input regarding both internal management at DWR and USBR and DWR and USBR' interactions with those who either use CALSIM II or would like to use it in the future.

Interviewee Thoughts and Suggestions

1. *CALSIM II has improved communication and cooperation between DWR and USBR*. There is wide agreement that the model has fostered positive interactions between DWR and USBR staff. This creates a more positive environment in which innovation is easier. However, some interviewees suggest that there is still need for improvement in this area.

2. *Communication between CALSIM II developers and other agency staff needs to improve*. Many interviewees express a desire to provide input to ongoing development of CALSIM II. While some groups feel that model developers are responsive to their feedback regarding how well the model performs specific functions, many feel that their input does not receive such attention. This disconnect in communication is attributed to the enormous scope of the model and the specialized nature of agency staff. Modelers may not be experts in the system being modeled, and different individuals throughout DWR and USBR have different areas of expertise. Those who have had significant access to model developers report that CALSIM II now performs substantially better in their areas of concern as a result of their involvement and input to the development process.

3. *DWR and USBR need to communicate better to control users' expectations regarding CALSIM II*. CALSIM II was initially sold as an easily accessible model that could be run by almost any interested party. As a result, many users have expectations that are out of step with the actual model. In fact, CALSIM II is extremely complex, and so it is important for agency staff to work with the user community to ensure that expectations are realistic. The disconnect between expectations for CALSIM II and its actual capabilities can undermine the model's

credibility and prevent or discourage support for its use and results. It is therefore important for DWR and USBR to articulate realistic requirements for running the model as well as limitations for its appropriate use and application.

4. *Agency managers should be more responsive to user feedback*. Some interviewees feel that CALSIM II managers are defensive in the face of criticism, although some see improvement in this area. Many suggest that including more stakeholders in the development process or providing a forum for input from model users will enhance CALSIM II's acceptance and credibility. The CALSIM ANN Refinement Team (CART) is cited as a positive example of such inclusion of different users. There is wide agreement on the benefits associated with transparent and accessible management of the model.

5. *CALSIM II's development was based on previous models, not on the questions it needs to answer*. Some interviewees express concern that developers created CALSIM II along the lines of similar models, especially DWRSIM, rather than building it specifically to perform the analyses to which it would be applied. One interviewee suggests that stakeholders' political concerns were one reason that CALSIM II was developed this way and that a more cooperative development approach would have yielded a better model. As a result, CALSIM II may not be ideally suited to some of its applications. In addition, many weaknesses of the earlier models still exist in CALSIM II. Interviewees indicate that regardless of this issue, the large quantity of resources invested in CALSIM II guarantee its use. Some suggest that water managers should start thinking now about the questions that the next generation of models will face and how best to address them.

6. *Management of CALSIM II is better than it was for earlier models*. While many interviewees see room for improvement in CALSIM II management, many also feel that model managers are more responsive than they were regarding DWRSIM and PROSIM. There was some effort to solicit input from stakeholders during the development of CALSIM II, and interaction between managers and users is seen to have improved in general.

D. Credibility

Comments regarding credibility discuss the confidence of users in the California water community regarding CALSIM II results. These express confidence in and concerns about CALSIM II in contrast with earlier models and other available models. They also address the adequacy of CALSIM II to perform the analyses to which it is applied.

Interviewee Thoughts and Suggestions

1. *CALSIM II is the "best available" model of the SWP and CVP*. Many interviewees indicate their belief that CALSIM II is currently the best model of the SWP and CVP systems. However, many feel CALSIM II needs to be better still for many uses.

2. *CALSIM II is an improvement over previous models*. Interviewees typically agree that CALSIM II represents an improvement over both DWRSIM and PROSIM, although many also note room for further improvements. Identified

improvements over previous models include more detailed inputs such as hydrology and demands, less uncertainty associated with results, increased transparency, the open-source environment, and the ability to model such complex operations as (b)(2) and EWA.

3. *CALSIM II is gaining credibility, but needs additional confidence*. While many interviewees agree that CALSIM II is the best model available and that it is an improvement over earlier tools, work is still needed to build acceptance and support. The credibility of previous models stemmed in large part from their use and application – users understood the tools, and results had been accepted widely, including in litigation. It will take time to build such a body of work using CALSIM II. In the meantime, many interviewees suggest that users will trust and support CALSIM II more once they understand it. The widespread lack of understanding of and/or confidence in the inner workings of CALSIM II has slowed development of this acceptance.

   Specific areas that interviewees feel could contribute to CALSIM II's credibility include improved accessibility, publication of a static benchmark study, documentation of limitations, and a competitive or equivalent model. CALSIM II was sold as a user-friendly model that would be easy to understand, and so its actual complexity has been a barrier to both use and trust. Some people would have greater confidence in CALSIM II if an unchanging benchmark study was available for comparison. Some want more documentation of the model's limitations. Others express distrust in a model that has no competitors or peers with which to compare its results. Some interviewees are simply critical of the model as insufficient to address the large, complex, and economically significant questions of water management in California.

E. Revisions and Updates

Comments regarding revisions and updates address modifications made to CALSIM II and studies produced by DWR and USBR. Comments focus on the many versions of CALSIM II that have been released and DWR and USBR' efforts to manage them.

Interviewee Thoughts and Suggestions

1. *Continuous updating of CALSIM II makes it a moving target*. CALSIM II has been under constant and ongoing development since its initial release, and some interviewees express frustration that many updates of the model have been released, often without clear documentation or announcement. There is no "official" version of CALSIM II. Because the model is easy to modify, many customized versions are in use, making it difficult to keep track of changes.

   The rapid turnover of model updates has two main effects. First, different updates can generate significantly different results for the same scenario, introducing unwelcome uncertainty into ongoing analyses. Users need to complete studies, and so they use interim updates to CALSIM II, even if that update is no longer the most current. Second, the continuous updates of CALSIM II make it a "moving target" which adds additional challenges for anyone trying to learn the model, or

to keep current regarding its latest developments. Few people have the time and energy to track all changes and take the time to understand them.

2. *It is important to keep improving CALSIM II, even if that means releasing updated versions*. Despite concerns regarding the constant changes to CALSIM II, interviewees still appreciate the ongoing development of the model and recognize the tension between the need for improvement vs. stability.

3. *CALSIM II needs better version control*. Developers have not done a good job of describing changes made between versions and communicating these to the public. CALSIM II is too complex for most users to be able to track and understand changes across multiple updates without guidance and an organized version control program. Changes associated with a new update should be documented clearly, using a consistent protocol. DWR and USBR are working on better version control software, which many interviewees agree is needed.

F. Calibration

Comments on calibration address the process through which model parameter values are adjusted until there is a close match between model results and historical data. Discussion includes appropriate uses of CALSIM II, given that it is not calibrated.

Interviewee Thoughts and Suggestions

1. *CALSIM II should be calibrated against the historical hydrology*. Some interviewees would like to see CALSIM II validated against at least a portion of the historical hydrology. They believe that this will increase the model's credibility.

2. *Calibration of CALSIM II to match real-time operations would be desirable, but difficult*. Planning models are fundamentally difficult to calibrate, and so this problem is not specific to CALSIM II. Nevertheless, some interviewees express interest in at least a comparison of CALSIM II results and real-time operations over a period of history. If CALSIM II could be calibrated to real-time operations, then it might be able to perform some of the functions currently performed by project operators' spreadsheet models.

3. *CALSIM II is adequately/inadequately calibrated*. There is no clear consensus among interviewees regarding the sufficiency of existing calibration efforts. Some indicate that more verification is necessary to enhance the model's credibility. Others state that calibration is unnecessary and should not be expected for a model such as CALSIM II.

G. Benchmark Study

The benchmark study is the official agency model study that defines operations for a particular level of development. It is intended to be a baseline case from which alternative scenarios are created and to which results of alternatives are compared.

Interviewee Thoughts and Suggestions

1. *Release of multiple versions of the benchmark study has made it difficult to use in analyses*. The purpose of the benchmark study is to provide a common baseline

for comparison. This is not possible when the benchmark itself continues to change and has not been finalized. As a result, there is no defined metric against which to compare CALSIM II results.

2. *CALSIM II needs a completed benchmark study to provide a point of reference for other analyses*. Some interviewees assert that a finalized, stable benchmark study will help address many questions regarding CALSIM II's limitations and credibility by providing both a solid sample study and a set of results against which to compare results of other analyses.

3. *There is room for improvement to the benchmark study*. Some interviewees express concern that it is not clear which outputs of the benchmark study should be used for comparison with other results. They feel that indicators for the performance of the study are not transparent and they may not apply to some other analyses. In addition, they perceive significant resistance to modifying the assumptions currently being used in the benchmark study, even if such modifications might improve it. There is concern that changing assumptions makes the benchmark study less useful for comparisons with other results.

III. IMPLEMENTATION

Model implementation refers to how the CALSIM software is applied to the CVP/SWP system (the resulting model of which is CALSIM II). Comments relating to model implementation were divided into: **mathematical formulation**, **operations representation**, **model complexity**, **time step**, **flexibility**, **management options**, **stability/sensitivity of solution**, **run time**, and **geographic representation**.

A. Mathematical Formulation

Mathematical formulation refers to how the system is represented as equations and inequalities. It includes the equations representing various physical processes (i.e., water quality, groundwater, surface and ground water interactions, etc.), carriage water computations, the setting of objective weights, feedback loops between objectives and operations, and computation of return flows.

Interviewee Thoughts and Suggestions

1. *Computation of salinity in the Delta needs to be improved.* There is a widespread concern vis-à-vis computation of salinity in the Delta, particularly implementation of the Artificial Neural Network (ANN).

   Many interviewees believe the ANN overestimates water required to meet Delta salinity standards. Several interviewees note that small changes in flow conditions in the Delta in CALSIM II result in large changes in Delta salinity and consequently carriage water costs and operations to meet salinity standards. One interviewee states that the ANN appears to need distinct model calibrations for each regulatory environment (i.e., D-1485, D1641, (b)(2), EWA), often resulting in inconsistent water costs. There is also concern that month-to-month impact analyses of Delta salinity may be unreliable, as while overall changes in water

supply across different runs may be small, differences in salinity could be significant.

Some interviewees express concern that the ANN is trained on DSM2 results rather than on real data. A few interviewees claim that the ANN does not match DSM2 (or FDM) results, usually over-estimating carriage water costs, but at times computing unreasonably low (or negative) carriage water. Nonetheless, use of the ANN is viewed as an improvement over PROSIM's Minimum Delta Outflow (MDO).

Many interviewees consider improvements to the ANN to be a high priority, given that much of system operations are driven by salinity constraints in the Delta. In that respect, the ANN CART process is viewed a positive step. Because of uncertainties in the ANN predictions, one interviewee suggests that the agencies should continue to support the G-model version of CALSIM II until the ANN has been adequately calibrated and tested. To avoid underestimating operators' ability to meet water quality objectives, one interviewee recommends that CALSIM II should account for effects of antecedent salinity conditions either by having a well-defined salinity carryover penalty or by implementing "look ahead and rules-of-thumb reflecting real-time operator decisions". Also proposed is implementation of a new flow-salinity relationship based on multi-component, non-linear regression.

Additional recommendations regarding computation of salinity in the Delta include: inclusion of more water quality stations in the Delta; operation of the system with the added objective of minimizing salinity conditions at Delta drinking water intakes; and computation of water quality for purposes other than meeting standards (e.g., to capture quality preferences in the timing of exports). Also recommended is training the ANN for major proposed structural and operational changes in the Delta.

2. *Water quality representation on the San Joaquin River is poorly represented in CALSIM II*, *particularly at Vernalis*. Current computation of salinity at Vernalis is considered weak, particularly under dry conditions. One interviewee proposes using a "deterministic algorithm" to compute salinity at Vernalis. The development and implementation of such an algorithm would require more field data.

3. *Groundwater representation in CALSIM II needs improvement*. Many respondents stress that representing groundwater and surface water/aquifer interaction is of considerable importance, requiring more explicit and detailed representation than currently exists in CALSIM II. Some interviewees indicate concern that groundwater basins are modeled as infinite sources, thereby violating mass balance principles and creating biases that also affect comparative analyses.

   Several interviewees comment on the need to improve representation of groundwater and surface water/aquifer interactions, either by better linkage

between CALSIM II and groundwater models (e.g., IGSM/CVGSM) or by fully implementing groundwater operations in CALSIM II. Effects of pumping on groundwater levels, better timing characterization of timing of sub-surface return flows, groundwater recharge, and impacts of transfers on groundwater levels are thought to need improvement. Better depiction of surface and groundwater interactions is thought to be especially important to adequately portray management options available at local and regional levels, such as conjunctive use and groundwater banking.

4. *The use of step-functions in CALSIM II causes small input changes to result in large output changes.* Model users consider step-functions to be the cause of difficulty in interpreting model results, as small changes in hydrologic conditions may result in large changes in modeled results. There is frequent thought that step-functions should be eliminated from CALSIM II. One interviewee, however, states that CALSIM II is an improvement over PROSIM, as step-functions have been eliminated.

5. *The option to re-start a CALSIM II run at any month during the year is an improvement.* One interviewee considers the recently implemented option to re-start a CALSIM II run at any point of the simulation, incorporating updated data on current conditions, to be an improvement.

6. *Feedback loops between environmental standards and reservoir operations should be automatic*. Concern has been expressed regarding the need to manually iterate the model to ensure that some environmental standards are met. Both with regard to biological objectives in the Delta and temperature objectives in streams, the lack of feedback loops is viewed as a weakness of CALSIM II. Feedback to operations for temperature and other biological objectives are suggested for CALSIM II.

7. *Mass balance is not preserved in EWA runs*. In modeling EWA, CALSIM II assumes the existence of a willing seller or water availability from the Yuba River. This water, claims one interviewee, is not taken from anywhere to preserve mass-balance. This results in the EWA cycle showing benefits relative to less stringent regulatory scenarios.

8. *Computation of return flows is inaccurate.* One interviewee asserts that return flows are computed based on surface water deliveries rather than based on surface water deliveries and groundwater pumping. Another interviewee concurs, stating that return flows are assumed to occur in the same month, neglecting the delaying effects of sub-surface return flows.

9. *CALSIM II does not do water routing.* One interviewee observes that lag-time response is an important feature of river and estuaries. The same interviewee notes, however, that this might not be as important for comparative analyses.

10. *CALSIM II uses a linear model to simulate a clearly non-linear system.*

11. *CALSIM II does not include year-to-year variation in evapotranspiration.*

B. Operations Representation

Operations representation refers to how the various operating constraints, objectives, and procedures are represented.

Interviewee Thoughts and Suggestions

1. *CALSIM II does a good job of representing the CVP/SWP system operations.* Several interviewees assert that CALSIM II does a good job (better than previous models) at representing system operations and environmental regulations. They consider its ability to reproduce time series and sequence of operations to be a strength. One interviewee points out that this strength is also a weakness, as the detailed representation of operating policies and regulatory constraints make it very difficult for most users to understand model results.

2. *CALSIM II inherited many simplifications from DWRSIM and PROSIM.* One interviewee states that CALSIM II developers have not updated many of the simplifications of local operations from its predecessors. Another cites the representation of San Luis Reservoir operations as an example of unfixed problems brought in from previous models. Another interviewee mentions that CALSIM II still uses a time-series of CCWD CVP diversions from the Delta from DWRSIM, rather than modeling CCWD diversions dynamically.

3. *Real-time decisions are poorly represented in CALSIM II.* Several interviewees contend that CALSIM II operations do not reflect real-time operators' decisions and guidelines. However, a few interviewees note that this is not unique to CALSIM II, as the intricacies of real-time operations are not easily represented in a model. This is particularly true regarding short-term decisions and biological objectives (such as fish take and water temperature). Therefore, one interviewee asserts, the calibration of CALSIM II to historical data would be difficult. However, one interviewee states that operators should use CALSIM II eventually to test alternative operating rules. Some interviewees, on the other hand, do not consider the ability to replicate real-time operations to be a problem as long as CALSIM II is used in comparative mode for traditional planning purposes.

   Better interaction between real-time operators and modelers is recommended to close the gap between model and real-time operations.

4. *CALSIM II does not use forecasting to estimate water availability.* Another aspect of operations representation relating to real-time operations is the lack of use of forecast information in simulated water allocations, particularly regarding snow-pack conditions. According to one interviewee, no feedback exists between demands and hydrologic conditions in CALSIM II. While operators use snow-pack conditions to update delivery predictions, CALSIM II does not. This limits CALSIM II's ability to match actual delivery allocations.

5. *Water allocation logic does not represent operators' decision-making process.* A few users express unease with the water allocation logic in CALSIM II, generally asserting that the logic does not represent operators' decision-making regarding exports and carryover storage or contractor behavior. The lack of explicit definition of risk is considered a weakness in CALSIM II, as is the use of the water supply index/delivery index (WSI/DI) curves, a holdover from DWRSIM.

One interviewee asserts that every time a new facility or demand is analyzed, the WSI/DI curves need to be re-calibrated; something that needs to be triggered manually or results will be inconsistent. One interviewee states that while CALSIM II allocates water based on the water year (October to September), the CVP allocates water starting in March and the SWP starting in January, making it difficult to compare CALSIM II results with short-term operations plans.

6. *CALSIM II overestimates/underestimates deliveries.* When compared to real-time operations, some interviewees claim that CALSIM II overestimates deliveries. Among the reasons cited for overestimating deliveries is the failure to simulate feedback between demands and hydrologic conditions. One interviewee, on the other hand, believes that operators can get more water out of the projects than CALSIM II predicts. Although comfortable with long-term deliveries simulated by CALSIM II, one interviewee is less sure of individual monthly predictions. While one respondent asserts that CALSIM II is fine for delivery reliability estimation, others claim that, for predictive purposes, CALSIM II deliveries should be de-rated. A few interviewees state that DWR is currently working on improving the allocation logic in CALSIM II, including iterating target deliveries with demands using LCPSIM.

7. *CALSIM II does not simulate drought operations realistically.* A few interviewees contend that drought operations, as simulated by CALSIM II, are considerably more aggressive than real-time operations, resulting in low carryover storage, particularly in the first year of a drought. Although interviewees generally agree that CALSIM II deliveries are higher than historical deliveries, the cause for the overestimation is not agreed upon. Some attribute the higher deliveries to faulty allocation logic, while others attributed it to the monthly time step or to poor representation of drought management flexibility (such as conservation, water transfers, groundwater banking, land fallowing, and conjunctive use) that generally reduces the demand for surface water during droughts.

   One interviewee expresses a need to plan for more realistic and/or extreme droughts, perhaps by using stochastic hydrologies.

8. *EWA and (b)(2) are poorly portrayed in CALSIM II.* Representation of the EWA and, to a lesser extent, (b)(2) is the subject of several comments, mostly expressing concern at its crude and speculative representation. Many interviewees acknowledge, however, that the EWA is difficult to model, not only because there is little experience and history, but also due to the nature of EWA as an adaptive management approach. It is generally recognized that the adaptive nature of EWA results in "fluidity of actual EWA actions" that are difficult to capture in a model. "The problem is one of trying to simulate a moving target", asserted one interviewee. Nonetheless, many regard this to be a topic of significant importance, requiring improvement in model representation. A few interviewees indicate that while the EWA and (b)(2) are poorly represented, the fact that CALSIM II simulates them at all is a considerable improvement over previous models. One interviewee disagree with others stating that CALSIM II current representation of (b)(2) is good.

Some interviewees suggest that given the nature of EWA and (b)(2), periodic review of their implementation in CALSIM II is warranted. One interviewee also expresses the need for an EWA workshop to refine that aspect of CALSIM II.

9. *Representation of Article 21 water is very crude.* One interviewee asserts that locally developed storage and treatment options have increased demands for Article 21 water more than is represented in CALSIM II. Another interviewee suggests that representation of Article 21 water, carryover deliveries, and conveyance operations could be improved by refining model assumptions and inputs.

10. *Refuge water operations need to be better represented.* Ponding operations are not included and agricultural efficiencies are incorrectly used to represent refuge water operations.

11. *Rice decomposition demands are not represented in CALSIM II.* Rice operations need to be revised.

12. *CALSIM II does not model carryover contract rights.*

13. *Operations representation of the Feather River is outdated.*

14. *Improvements were made to the representation of the SWP system, but not to the CVP system.* Some feel SWP operations are better represented than CVP operations.

15. *Implementation of SWRCB D-1644 on the Yuba River is a strength of CALSIM II.*

16. *Current representation might underestimate operators' abilities to meet water quality objectives.* Water quality objectives in the Delta can be met by a variety of release/export schedules over time, with significant differences in resulting water costs and quality. Depending on the study, release and pumping schedules should be either 1) typical or 2) optimized. Currently, flows are neither optimized over time nor account for typical operator behavior and expertise. This may underestimate operators' abilities to meet water quality objectives.

17. *Operating rules for additional water quality constituents should be developed.*

18. *More data are needed to derive operating rules for any in-delta storage facility.*

C. Model Complexity

Model complexity encompasses several aspects of using the model that make it less user-friendly. Comments relating to model complexity include the effort required to become proficient in running the model, interpreting results, and understanding how the model works.

Interviewee Thoughts and Suggestions

1. *CALSIM II's complexity reflects the complexity of the system.* It is generally recognized that the complexity of CALSIM II stems, at least in part, from the complexity of the system it simulates, particularly regarding the environmental regulations (various regulatory layers) that constrain system operations. Many interviewees contend that to be able to run CALSIM II, one must have a thorough

understanding of the system. It is often cited that CALSIM II faces greater challenges than its predecessors, as it has been used to analyze projects with very complex operations (e.g., Sites Reservoir and In-Delta Storage Facility).

2. *CALSIM II is difficult to learn, cumbersome, and not accessible.* The difficulty in learning and running the model has been a source of frustration to many users and potential users who view the model as cumbersome, not user-friendly, and lacking accessibility. One interviewee asserts that the WRESL language is very cryptic and that CALSIM II is difficult to modify even for simple analyses. The large volume of input and the sheer size of the model are also mentioned as causes for its complexity. Many expected the agencies to come through with the promise that CALSIM II would be a model that could be run on the "kitchen table". The experience of most users, however, is that it takes considerable time and patience to learn how to use CALSIM II. A few interviewees assert that CALSIM II is harder to learn than its predecessors, and that while DWRSIM and PROSIM could be used as tools to learn the system, CALSIM II cannot. Lack of adequate documentation exacerbates this problem in the minds of many interviewees. Some interviewees regret that, as with PROSIM and DWRSIM, few users are proficient at running the CALSIM II.

   There is a common consensus among respondents that CALSIM II should be more user-friendly so that stakeholders could run the model without hiring consultants. One interviewee suggests that not all features in CALSIM II are necessary for most applications, and that two versions of the model should be maintained by the agencies, allowing users to choose between a more complex model for detailed analyses and a simpler model for quick, gross analyses. Another interviewee suggests that CALSIM II would be a simpler if it were truly modular, allowing the model user to turn features on or off depending on particular analysis needs.

3. *CALSIM II results are difficult to interpret*. Many interviewees comment that interpreting CALSIM II results requires not only experience with CALSIM II, but also knowledge of the CVP/SWP system and linear programming. It is generally considered that much time is required to determine if model results are reasonable and that there is very little guidance from model developers in this respect. Without appropriate interpretation, one respondent states that "CALSIM II results provide more data than information". One interviewee suggests that when results are "way-off", it is hard to determine if the error is in the model or in the way it was run. Also, some interviewees claim that there are no specific criteria to define a "good" model run, or post-processing tools to help visualize, interpret, correct errors, and obtain answers to common questions.

4. *CALSIM II limitations, strengths, and weaknesses are not well understood.* A few interviewees assert that CALSIM II predecessors (PROSIM and DWRSIM) were used extensively for various purposes, including the support of court decisions. Consequently, their strengths and weaknesses were well understood and their results could be couched based on their limitations. A similar level of understanding of CALSIM II will take time to develop.

D. Time step

Several comments under model implementation are about the time discretization used in CALSIM II.

Interviewee Thoughts and Suggestions

1. *A monthly time step cannot capture hydrologic variability.* Several interviewees note that a smaller time step (weekly or daily) would better capture hydrologic variability and thus availability of surplus flows, a significant element in the accurate computation of exports (and export capacity), transfers, and the operations of proposed projects such as Sites Reservoir and In-Delta Storage. Many respondents express concern that, in a monthly model, large flows occurring during part of the month (particularly during spring months) are averaged out allowing for the apparent ability to run export pumps at capacity the entire month, therefore over-estimating exports. For the same reason, environmental standards tend to be more easily met in monthly models, something said to be apparent in gaming exercises.

2. *A monthly time step is too large to adequately represent many aspects of the system.* Several interviewees regard the monthly time step to be too large to adequately represent many aspects of system operations, particularly Delta operations. A few interviewees comment on the unsuitability of a monthly model to simulate EWA, VAMP, flood control, Article 21 and re-scheduled water, and the many environmental standards that are on a scale of days. Also, for analyses that require interfacing with DSM2 or the estimation of water temperature impacts, a monthly model is felt to be inadequate.

   Several interviewees articulate a need to have CALSIM II run at a shorter time step. While some consider weekly or bi-weekly to be sufficiently small to capture most aspects of operations, others emphasize the need to have CALSIM II run at a daily time step. A daily time step is thought to be necessary particularly for studies that require the interface with hydrodynamics (DSM2 or the Fischer Delta Model) or water quality models, the analyses of water transfers, Article 21 and re-scheduled water, and the analyses of proposed projects that would make use of surplus water (Sites Reservoir and In-Delta Storage Facility). One interviewee suggests that the appropriate time step for CALSIM II should be determined through an open process, which would also identify what it would take to move to a shorter time step if that was deemed appropriate.

   However, several interviewees are unconvinced that a shorter time step is required. One interviewee is uncertain if reducing the time step would be either more accurate or useful, given the additional data and assumptions that would be needed to characterize the system. Another interviewee claims that for planning activities, a daily model seems unnecessary.

   Others claim that moving to a daily time step might worsen some problems due to issues of precise timing of short events. While agreeing that shorter-than-monthly decisions were important, these issues might be addressed by more thoughtful implementation of a monthly time step.

E. Model Flexibility

Comments on model flexibility address the ability to easily modify and adapt the model to reflect various assumptions and scenarios.

Interviewee Thoughts and Suggestions

1. *Flexibility is CALSIM II's "greatest strength".* There is a general consensus among CALSIM II users that the model is very flexible, allowing for the analysis of proposed facilities and regulations, alternative operating rules and demand scenarios, and the extension to other geographic areas. One interviewee disagrees, however, stating that operating rules and north-of-Delta demands are not easily modified in CALSIM II. Furthermore, despite being a very flexible model, one interviewee claims that much effort is still needed on basic input data.

2. *CALSIM II is more flexible than previous models*. Model flexibility is regarded as strong, particularly when compared to previous models of the CVP/SWP system, PROSIM and DWRSIM.

3. *CALSIM II flexibility is also a weakness, as many versions of the model are being used concurrently.* A few interviewees regard flexibility to be both strength and a weakness, as frequent modifications often result in many versions of the model being used at the same time, and consequently problems with version control.

4. *The flexibility of CALSIM II is hampered by the difficulty in setting the weight structure*. One interviewee concurs that CALSIM II is very versatile, but commented that the setting of weights once model changes have been made can be difficult.

F. Representation of Management Options

Comments in this area relate to CALSIM II's ability to represent many water management options available at local and district levels, such as water transfers and exchanges, re-scheduled water, conjunctive use, desalination, water conservation, etc.

Interviewee Thoughts and Suggestions

1. *CALSIM II does not represent local projects that contribute to water supply.* A few interviewees consider the ability to understand how local, regional, and state facilities and options best go together to be very important. CALSIM II should "simulate the system rather than the components of the system (CVP and SWP) that used to be most important", asserts one interviewee. Several respondents claim that local and regional management options (conjunctive use, groundwater banking operations, desalination, recycled water, etc.) that can reduce stress on the CVP/SWP system, particularly during droughts, are not included in CALSIM II.

   While several interviewees suggest that CALSIM II should implement better local and regional management options, one interviewee proposed using CALSIM II interactively with other models that include management options available at regional and local levels.

2. *Currently, CALSIM II is not able to simulate water transfers adequately.* While one interviewee stated that CALSIM II must be able to track project and non-project water to adequately represent transfers, another contends that water transfers should be economically driven and not individually pre-specified. One interviewee indicates that to capture the time windows of opportunity for water transfers, CALSIM II must be able to adequately represent Delta operations.

3. *CALSIM II should include conjunctive use of Colorado River and Delta exports.*

4. *CALSIM II is not able to track water that belong to different entities (a.k.a. "colored water" or "water with different names").*

5. *CALSIM II should be able to model water exchanges between MWD and the Friant and Kings River systems and the integration of those exchanges into the SWP system.*

G. Stability/Sensitivity of Model Results

Stability or sensitivity of model results refers to how small changes in model input may result in disproportionate differences in model results.

Interviewee Thoughts and Suggestions

1. *Small changes in CALSIM II input can result in large changes in model results.* Interviewees remark on the stability or sensitivity of CALSIM II results to small changes in input (also a weakness of CALSIM II predecessor, DWRSIM), and that it is not clear to which parameters CALSIM II is highly sensitive. A few interviewees state that the LP formulation allows for multiple solutions, which can differ considerably. This can be a problem when weights are improperly set, assert one interviewee. Therefore, a small change in input may result in disproportionately large changes in model results, causing difficulties in impact analyses and the defensibility of model results.

2. *CALSIM II may not be reliable to estimate month-to-month impacts of salinity.* It is difficult to know if resulting salinity estimates are real, or merely artifacts of the model. However, even when flow and delivery consequences are small, they may have greater changes in salinities. Presentation of results as averages might be more appropriate.

3. *CALSIM II results appear to be insensitive to changes in some inputs, especially annual requested deliveries.*

4. *It is easy to have the results of a CALSIM II run fall within the "noise" of other water being moved around for (b)(2) and EWA, which may obscure the effect of the change to the system being modeled.*

5. *The same year-type does not always produce the same flows.* One interviewee remarks that the range of CALSIM II results for each year type is very broad and often inconsistent (e.g., allocations in wet years may vary from 50 to 90 percent). Such inconsistency discourages the use of CALSIM II.

H. Geographic Representation

Comments under this category were specific to certain region/basins that were considered either strengths or weaknesses of CALSIM II. Comments relating to the geographic representation in CALSIM II were categorized either under model mission or under model implementation, depending on whether they refer to the geographic extent and scale intended to be represented in CALSIM II (Mission), or how the regions modeled are represented in the model (below).

Interviewee Thoughts and Suggestions

1. *CCWD diversion should be represented by two arcs.* Some interviewees contend that two arcs should represent CCWD diversion from the Delta, one for each type of diversion available to the district (i.e., CVP water and Los Vaqueros right for Delta surplus water).

2. *CALSIM II does not accurately represent the Yuba River system.* Two comments regarding Yuba basin representation conflict. While one interviewee asserts that CALSIM II did not accurately represent the operations of reservoirs in the Yuba basin, another interviewee affirms that the depiction of the SWRCB D-1644 is a strength of CALSIM II, when compared to previous models.

3. *CALSIM II should include a scaled down physical model of the Delta.* One interviewee asserts that the Delta should be represented at a greater level of detail to capture the most important hydrodynamic relationships. Such a representation would reduce or avoid the need to recalibrate Delta salinity relationships with changes in Delta operations.

4. *Representation of the Stanislaus River needs to be improved.*

5. *The Upper American River is not well represented.*

6. *The representation of the San Joaquin River is weak.* One interviewee asserts that the San Joaquin River tributaries and Mokelumne Reservoirs operations have been "hard-wired", while another interviewee would like to see a better representation of the linkages between the East and West sides of the San Joaquin Valley.

7. *Representation of the Feather River operations is outdated.*

8. *CALSIM II provides a good level of detail of the Central Valley system for CVP/SWP impact analyses.*

9. *The Sacramento Valley is modeled at too aggregate a scale in CALSIM II*. It fails to capture the diversity of demands and supply rights.

10. *The spatial discretization in CALSIM II should be refined*.

I. Run Time

Run time refers to the time taken to perform one simulation over the entire period of record. This does not include user time for checking results, output interpretation, and quality assurance.

Interviewee Thoughts and Suggestions

1. *CALSIM II run time is/is not long.* Interviewees state that, depending on the computer used, a CALSIM II run might take three to seven hours. In contrast, DWRSIM and PROSIM took a few minutes per run. The run time is considered to be too long by several interviewees, preventing the use of CALSIM II as a screening tool or for detailed analyses. One interviewee states that CALSIM II run time prevents it from being used to answer policy questions, as those arise frequently and require quick answers. One interviewee understands that the greater run time is, at least in part, due to the modeling of the various new regulatory layers. Nonetheless, the discovery and correction of input mistakes is a long process. Two interviewees, on the other hand, considers the run time of CALSIM II to be short, particularly when compared to DSM2.

   Recommendations to reduce CALSIM II run time include re-coding the model to allow for parallel processing and improving the data transfer efficiency between the modeling layers.

J. Other

Interviewee Thoughts and Suggestions

1. *CALSIM II formulation should be made more robust so that runs are not user dependent.* One interviewee asserts that starting from the same point, different model users will likely produce different CALSIM II output. "To produce an acceptable CALSIM II run, intermediate results are viewed and model parameters are adjusted until the desired result is reached". Sensitivity to this type of manipulation should be quantified and compared to differences between alternatives in the same study, and the model should be made more robust so that user significance is reduced.
2. *There are probably several things that could be done differently in CALSIM II, but these are often just individual preferences and not real weaknesses in the model.*

IV. INPUTS

This section summarizes comments made regarding CALSIM II input data. Most comments relating to input data refer to either hydrology or demands.

A. General Comments

Interviewees made several general observations on input data.

Interviewee Thoughts and Suggestions

1. *It is difficult to make CALSIM II inputs tangible and communicable to stakeholders.*

2. *CALSIM II input data are weak/strong.* Several interviewees claim that input data are weak and lagging far behind other aspects of model development. One interviewee states that despite its capabilities, CALSIM II is not a better product than previous models, as much effort is still needed on basic input data. One interviewee states that CALSIM II input data seem to be "pretty good".

3. *"There appears to be a culture where some inputs are so accepted that they are no longer scrutinized or even understood by some of the current CALSIM II modelers."*

4. *"For DWRSIM, many parameters were quantified very subjectively."*

5. *The level of detail used in CALSIM II to characterize the system is too high.* One interviewee expresses concern at the detailed system characterization used in CALSIM II and the ability to develop the required assumptions. Mischaracterization of the system makes use of CALSIM II "dicey for policy purposes," as data seem unavailable to calibrate the model at this level of detail.

B. Demands

Comments regarding input demands discuss the various aspects of developing water demands that go into CALSIM II.

Interviewee Thoughts and Suggestions

1. *CALSIM II demands should be land-use based, not contract based.* Many interviewees advocated implementation of land-use based demands in CALSIM II as a means of refining demand representation. One interviewee indicates that deliveries in CALSIM II are much greater than historical deliveries because CALSIM II tries to meet target deliveries every year rather than take climate into account and decrease deliveries accordingly. One interviewee holds that land-use based demands have already been implemented in the Sacramento Valley, and are currently being developed for the 2030 level of development in the San Joaquin Valley. Other respondents suggest developing land-use based demands for south of the Delta. One interviewee further stresses the importance of accurately estimating demands and that demand estimates are too high and can skew policy decisions.

   Having CALSIM II be more land-use based than previous models is viewed as an improvement. One interviewee suggests using GIS to capture land-use with finer spatial discretization.

2. *Water use efficiency values are based on out-dated numbers.* Several interviewees express concern over water use efficiency values used in CALSIM II, stating that these numbers are based on calculations made in the 1960's, when efficiency values were much lower than they are today.

   Interviewees suggest that more current water use efficiency values be developed and implemented in the development of demand and hydrology data.

3. *CALSIM II can only be useful for policy purposes if it uses economics and price in determining demands.*

4. *CALSIM II needs to be able to model demands based on actual demands.* One interviewee states that CALSIM II demands are based on climate, and that MWD modeled demands are highest during dry periods and lowest during wet periods. In practice, MWD demands are highest in the wet periods, when the district tries to fill storage facilities. On the same topic, another interviewee asserted that CALSIM II iterates with MWD's IRPSIM so that annual delivery targets better represent local demands.

5. *There should be iteration between CALSIM II and CVPM.* Land-use data from CVPM is used in CALSIM II. However, one interviewee claims that the two models are not used iteratively. Moreover, concerns regarding the validity of CVPM and its successor, CALAG, affect the validity of CALSIM II.

6. *Rice decomposition demands are not represented in CALSIM II.*

7. *Refuge water demands need better representation in CALSIM II.* One interviewee asserted that agricultural efficiencies are incorrectly used.

8. *Consensus alternative demand scenarios that can be easily implemented in CALSIM II should be developed.* It is difficult to use CALSIM II for broader state and CALFED purposes if effects of water demand management actions cannot be brought into CALSIM II.

9. *Representation of demands in CALSIM II is not intuitive.* One interviewee states that representation of demands in CALSIM II is complex and not well documented. Another interviewee states that it is not clear if changing contract amounts changes demands in CALSIM II.

C. Hydrology

Comments on input hydrology address the level of detail, methodology, data, and basic values used to develop CALSIM II hydrology.

Interviewee Thoughts and Suggestions

1. *"There has been a lack of work on the hydrology underlying the model".* "Hydrology problems include: demands, efficiencies, reuse, and losses are based on 1970's studies (the data are out of date); no good handle on groundwater pumping; forecasting methodology is different from that used by DWR's Office of Flood Management; poor project/Non-Project splitting of land-use based demands; poor representation of local supplies (e.g., smaller unregulated supplies and the location of their return flows); and CALSIM II lacks representation of indoor non-consumptive use and local water sources for M&I demands*."*

2. *CALSIM II's hydrology needs improvement.* While CALSIM II's hydrology is widely considered better than previous models, many model users contend that the hydrology requires further refinement. One user states that errors in the hydrology propagate through each layer of the model, making it one of the most important aspects of CALSIM II. Many interviewees suggest that the hydrology is based on methods and data from the 1960's and 1970's. Such methodology is no longer considered appropriate as CALSIM II is being used to evaluate much more complex questions than before. A finer geographical representation is

deemed essential to capture the complexity of the system, particularly with respect to water supply sources. Agreement on a joint hydrology, however, is generally viewed as a strength of CALSIM II, although many users would like to more information on the details of its development.

Additional recommended enhancements to CALSIM II's input hydrology include consumptive use modeling, better estimates of evapotranspiration and soil characteristics, greater spatial discretization, and refinement of CVGSM for more localized applications.

3. *Hydrology development should be based on land-use.* As with development of demands, many interviewees state that the development of hydrology should be based on land use patterns. One interviewee proposes use of GIS so that land-use changes can be better and more easily incorporated. One interviewee states that the land-use based hydrology implemented in the San Joaquin Basin is an improvement.

4. *Hydrology development should be thoroughly documented and transparent to model users.*

5. *Use of historical adjusted hydrological sequences is a strength.*

6. *Hydrology other than for a fixed level of development should be developed.* Interviewees express interest in development of climate change hydrologies and synthetic hydrologies to evaluate more severe drought scenarios. One interviewee suggests the development of unimpaired flow data reflecting pre-development conditions rather than a particular level of development. However, a few interviewees suggest that development of alternative input hydrologies is a clumsy and time-consuming process, with a prohibitive turn-around time.

7. *Data gaps in hydrology need to be addressed.* A few interviewees comment on the lack of hydrologic data, particularly groundwater and basin efficiencies, the latter considered very low. More information also is needed on rim flows, M&I accounting, and farm level processes.

8. *Current accretion/depletion analysis is very gross.* A few interviewees state the need to refine the accretion/depletion analysis in CALSIM II.

9. *Local hydrologic assumptions for CVPM and CALSIM II do not always agree.*

10. *The Yuba River hydrology is a problem.*

11. *Rainfall-runoff simulations for small catchments are poor.* One interviewee states that rainfall-runoff simulations are based on weak empirical relations and that more detailed information is not available.

12. *CALSIM II should include recent years hydrology.* While one interviewee comments that the 80-year hydrology provides a wide range of hydrologic impulses, several other interviewees would like to see CALSIM II incorporate more recent hydrology, including the past two years.

13. *"Hydrology forecasts should be better represented in CALSIM II."* One interviewee asserts that forecasted inflows are used in a few, but not all, basins. Another interviewee would like to see the logic in CALSIM II to use snow-pack information to be more in line with real-time operations.

V. SOFTWARE

CALSIM is a generalized water resources system simulation software. CALSIM II is the agencies' application of the CALSIM software to the CVP/SWP system. Comments on CALSIM software cover the **solver**, **graphical user interface** (**GUI**), and **post-processing** capabilities for presenting model **output**. **Database structure and data management software** needs also are included, as are issues related to the **data storage system** (**DSS**), the **WRESL** language, and use of an **optimization** engine, rather than traditional **simulation**.

A. Solver

Comments address a range of concerns regarding the CALSIM linear program solver.

Interviewee Thoughts and Suggestions

1. *Solver output hinders debugging and error messages provide little assistance*. The solver provides no information on the location of infeasibilities. Multiple interviewees state that it can take many days to debug a run, often requiring someone to re-do a run step-by-step to identify a problem.

2. *Solutions are often unstable*. The solver sometimes produces non-unique solutions. In addition, running identical scenarios on different computers seems to generate different results. Small changes to inputs also can cause significant changes in results. Some interviewees suggest that this is a function of using an LP formulation with equally weighted penalties, having multiple optima.

3. *The solver provides no sensitivity analysis*. The solver does not provide any of the sensitivity analysis that LP solutions usually offer. There is no indication of which parameters are constrained, and so users have to "dig" for this information on their own. Some express specific interest in a sensitivity analysis for hydrologic and demand inputs.

4. *A free solver would be preferable*. The currently used commercial XA solver is expensive. Furthermore, a separate license is required for each run that is underway at any point of time, effectively requiring multiple licenses for parallel runs of CALSIM II. Some interviewees also are hesitant to invest in a commercial solver when there is no guarantee of how long CALSIM will continue to use it. Several interviewees suggested switching to a free public-domain solver to address these concerns.

5. *Use of an LP solver is an improvement over past models*. Some interviewees support the move to an LP solver and like its efficiency, flexibility, and that it emulates operator behavior well. However, some feel CALSIM II's structure still reflects older FORTRAN code such that the model does not take full advantage of the LP solver. Other interviewees indicate that use of an LP solver is not good at

the monthly level due to multiple optimal solutions, which can produce different solutions given the same inputs.

B. GUI (Graphical User Interface)

Comments assess the interface used for extracting, viewing, and displaying CALSIM II inputs and results.

Interviewee Thoughts and Suggestions

1. *Users would like a more intuitive, geographically referenced interface*. Such an interface would help users understand both inputs and outputs. Some interviewees would like this to be linkable to a GIS.
2. *Users would like a GUI that shows the current CALSIM II schematic*. A GUI that offers information linked to a CALSIM II schematic would provide users with both a current schematic and a logical presentation of information. Several interviewees would like an interface in which they can click on a node and see relevant information, including input data, metadata, water balances, and information on the location of relevant equations. Several agency staff members mentioned that currently work on an interface that will perform at least some of these functions is currently underway.
3. *The existing GUI needs improvement*. Many interviewees agreed that the existing GUI does not perform necessary functions. Specific recommendations include allowing users to compare parameters across model runs and to extract data in different formats.

C. Output/Post-processor

Comments explain interviewees' opinions of the current presentation of CALSIM II output and their preferences for additional utilities or functions. Feedback addresses the need to post-process and present results in a clear and useful format.

Interviewee Thoughts and Suggestions

1. *It is currently difficult to extract results from CALSIM II*. Many interviewees describe the need to post-process results extensively to obtain information they need. Individual users are developing their own post-processing techniques, creating potential for inconsistencies between runs. Interviewees agree that a common post-processing utility that can present basic flow, storage, and delivery results would be valuable. Such a post-processor would help not only with interpreting results, but also with understanding and correcting errors in a model run.
2. *Users would like visual tools with which to present and compare multiple CALSIM II runs*. It is currently necessary to obtain the results of separate model runs and import them into a spreadsheet to calculate differences between them. Interviewees expressed interest in tools, both computational and especially visual, that would make it easier to compare results across runs.

D. Database/Data Management Software

Databases store all model data and metadata. Data management software allows users to link files and functions within CALSIM. It also can manage CALSIM II's interface with other models. Feedback includes comments regarding data management needs associated with CALSIM II. Many of these address the pros and cons of switching to a database structure.

Interviewee Thoughts and Suggestions

1. *The CALSIM data structure is prone to user error*. There are many input files and almost no automated quality control. In addition, each model run requires a new directory of input files and different software utilities are required for various inputs and links between model sections. All of this adds up to a time-consuming, generally manual process for setting up a CALSIM II run that leaves substantial room for error. Many interviewees would like the agencies to restructure inputs so that they are entered in a relational database such as MS Access, rather than in the current text files. Such a database could also store metadata. Members of the agency staff currently are working on such a database structure for both input files and WRESL code. There is also interest in a utility that could generalize and facilitate the QA/QC process as a whole.

   In addition to concerns regarding user errors during the data input process, some interviewees express similar concerns regarding output from CALSIM II that is used as input to other models. They would like CALSIM II to have the ability to generate these input files automatically.

2. *CALSIM II needs a better data management system*. Interviewees largely agree that CALSIM II would be easier to use if it had a simpler and more coherent data management system. Particular functions mentioned for such a system include the archiving of calculation files and the ability to conduct multiple traces of dependencies.

E. DSS (Data Storage System)

HEC-DSS (DSS) is the database system used to store time-series input and output data for CALSIM.

Interviewee Thoughts and Suggestions

1. *Results are presented in an inaccessible format*. Interviewees commonly find the existing DSS system difficult to use. Output files are large, and there is no standard tool with which to move them into a spreadsheet. In addition, DSS files do not provide the possibility of adding metadata to input files. Interviewees would either like a utility with which to extract data from DSS files and move them into a spreadsheet format or an entirely new data storage structure such as a relational database. Despite this criticism, some interviewees assert that the current DSS system is an improvement over past formats.

2. *It is difficult to identify output files by their DSS labels*. It is difficult to identify outputs based on their DSS pathnames. Pathnames also do not provide information on the origins of any given output. Furthermore, the current DSS structure makes it difficult to extract data for a specific node.

F. WRESL (Water Resources Simulation Language)

DWR developed the Water Resources Simulation Language to use simple commands to set up networks, constraints, weights, and other features in CALSIM. Comments address the WRESL language, often in comparison to the FORTRAN code used in previous models.

Interviewee Thoughts and Suggestions

1. *WRESL is easy to understand and increases the transparency of the model*. A number of interviewees agree that WRESL is easy to understand and helps to explain the functionality of CALSIM II, although some found it hard to learn at first.

2. *Specific aspects of the WRESL language need improvement.* Some interviewees feel that WRESL should be more flexible. They see the need to expand or modify the language so that users will no longer have to work around its limitations. Others describe WRESL as cryptic and have experienced problems when modifying WRESL code in one part of CALSIM II caused errors in other parts of the model. Some interviewees see the need for additional documentation, while others wonder why model developers abandoned FORTRAN code at all.

G. Transparency

Transparency describes the quality of the software that makes the model and its functions clear and intelligible to model users

Interviewee Thoughts and Suggestions

1. *CALSIM II is driven entirely by data, and so it is very transparent*. Many interviewees state that because CALSIM II is driven by its input data, none of the operating rules or data are embedded in its source code. This means that users manipulate input data and create the input files, making for a transparent process. Some interviewees also find that CALSIM II's structure makes assumptions relatively transparent. Some deem CALSIM II more transparent than DWRSIM or PROSIM.

2. *Not all functions in CALSIM II are transparent to users*. Despite the intended transparency of the data input structure, some interviewees find the huge number of input files required by CALSIM II to be daunting, thus reducing the effective transparency. Others find it difficult to determine the potentially multiple features and functions of different nodes.

H. Simulation vs. Optimization

CALSIM is a generic simulation model that uses an LP solver (optimization) to route water throughout the network and allocate water to the various competing uses to simulate system operations. Comments address the value of using an optimization engine vs. traditional simulation.

Interviewee Thoughts and Suggestions

1. *The optimization engine is an asset to CALSIM II*. Many interviewees feel that the use of an optimization engine for CALSIM II is a step forward from previous

models and that it is appropriate given that (b)(2) accounting and the Environmental Water Account try to optimize water use. Others are supportive of the engine, but feel that its full capabilities are not yet in use.

2. *There is some confusion about the role and use of the optimization engine in CALSIM II*. Some interviewees are unsure of how the optimization engine works within CALSIM II, while others feel that an optimization approach does not make sense given the many constraints of the SWP and CVP systems.

3. *A pre-processor to generate weights for CALSIM II would be helpful*. A pre-processor such as the one used in MODSIM would allow users to specify priorities and would then use those priorities to generate weights. This would be preferable to the current system in which the user specifies weights directly.

4. *There is some interest in implementing Monte Carlo simulation in CALSIM II*. Some interviewees express interest in enhancing the similarities between CALSIM II and Metropolitan Water District's IRP model, which uses a Monte Carlo approach.

I. Other

Interviewee Thoughts and Suggestions

1. *There is general satisfaction with the software*. Interviewees commonly express appreciation for CALSIM's ease of use, general strength, and potential applicability to other basins.

2. *CALSIM II's logic does not take full advantage of its software package*.

3. *Using a FORTRAN compiler is cumbersome and unnecessary*. The current FORTRAN translator and compiler slow the run time and can cause problems. Developers should implement a different compiler, although interviewees acknowledge that this might require substantial re-writing of the CALSIM II software.

4. *CALSIM II should be structured entirely differently*. Some interviewees would like to be able to run base and alternative scenarios simultaneously, with the model generating differences between the runs automatically. Others would like to see CALSIM II structured as a spreadsheet model with individual pages for assumptions, input data, and results.

5. *CALSIM II needs a tool to generalize the QA/QC process*.

CONCLUDING REMARKS

This report contains the thoughts of 89 members of California's water management community on California's principal water management model, CALSIM II. These thoughts came from an extensive series of in-person and telephone interviews conducted over a four-month period, with each interview resulting in a summary reviewed by the interviewees.

The interviewees noted a wide variety of current and proposed uses for the CALSIM II model, including ranges various planning, regulatory, and operational purposes. Most of these purposes call for "comparative" use of the model, whereby proposed facilities and operations are compared with some base case to provide conclusions regarding relative performance. However, many uses are call for "absolute" or "predictive" use of the model, where results of a single model run are used directly to assess performance or regulatory compliance or as input into local or project operations decisions.

The main body of the report consists of thoughts and insights offered by the interviewees regarding CALSIM II issues, ranging from model administration and mission to details of implementation, data, and software. The many thoughts offered were summarized into hundreds of thoughts, sorted into 5 major categories and 31 sub-categories in the body of this report. The raw thoughts from the interview summaries appear in appendices to this report.

The current and prospective purposes of CALSIM II and thoughts and insights given by the interviewees should be useful for:

- Purposes of external review,
- Identification and prioritization of further model development activities, and
- Education and outreach activities that would make the model better understood and more useful.

APPENDICES

APPENDIX A: QUESTIONNAIRE

CALSIM II Questionnaire: Model uses and experiences
DRAFT 4 May 2003

Introduction
The purpose of these interviews is to gather some of the background information for an anticipated independent external-review of CALSIM II modeling by a panel of nationally-recognized experts in large-scale water resource system modeling. Information gathered in these interviews is to include existing and potential uses and questions for CALSIM II, why people select this model, and their views of what alternatives might exist or what they might like to see in alternative operations and planning models. The interview results also will provide information useful to the current Bulletin 160-03 California Water Plan Update Advisory Committee, CALFED, FERC re-licensing, and other relevant planning processes employing or considering CALSIM II.

The panel review following these interviews is to provide an independent analysis and constructive suggestions about the strengths and weaknesses of CALSIM and CALSIM II, appropriate uses of these models, ways their use might complement or be complemented by other models, and provide advice and suggestions for further development, quality assurance, and use of operations and planning models for California and its major water systems. The panel review will be conducted by technical experts who will base their review on existing documentation, specific examples of model use, interview results, and their background in the use of similar and alternative planning models in other settings. The panel review results should also inform Department of Water Resources and US Bureau of Reclamation in their efforts to improve, test, or replace CALSIM II and inform users and developers of CALSIM II as to the model's best uses and their most technically important concerns.

The results of this survey will provide background information for this panel. It is important for the expert panel to have an understanding of the types of problems that water community members are trying to solve and what analytical tools they are employing.

Each interview results will be summarized in writing for each interviewee, who will then have two weeks to revise and extend their remarks. Each interviewee may select any portion of the summary (including the entirety) to be included in remarks "not for attribution." Thus, an interviewee may submit comments on CALSIM II both for attribution (in an identified personal, professional, or institutional capacity) as well as anonymous comments. If an interviewee wishes all comments to remain anonymous, this is also possible. However, the names of all interviewees will be listed in a separate appendix. The only exception is that employees of DWR and USBR who request anonymity will not be named, but will be included in a total of "X DWR and Y USBR employees." The written summary comments of all interviewees (anonymous and for attribution) will appear in an appendix to the report. Interviewees may also submit

separate written statements, documents, or materials for inclusion or citation in an appendix to the report.

Interviewees are selected from a broad base of agency, consulting, stakeholder, and organizational perspectives, based on their technical reputation in modeling major water systems in California. Thirty to forty interviews are expected.

Contact information: Jay R. Lund, Professor, Department of Civil and Environmental Engineering, University of California, Davis, jrlund@ucdavis.edu

DRAFT Interview Protocols

Opening statement: The purpose of these interviews is to gather information about existing and potential uses of CALSIM II, why people select this model, what they are most and least confident of in their use of the model, and their views of what alternatives might exist or what they might like to see in alternative operations and planning models. This information should be useful for a later external review panel and other activities.

Interviewee should already have received the introductory statement (above) via email, but the interviewer should have a copy to go over with the interviewee if needed or desired. After the interview, we will summarize your remarks in written form; you will have two weeks to revise and extend this summary. You may designate parts of this summary to be separated under remarks "not for attribution." You also may electronically submit additional material for inclusion or citation in a report appendix.

DRAFT Questions

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

6) If CALSIM II were unavailable for your purposes, what would you use?

7) For your organization, who inside or outside your organization: (name and affiliation)

a) prepares and executes CALSIM II runs?

b) interprets CALSIM II results?

c) uses CALSIM II results?

d) works on CALSIM II development?

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

APPENDIX B: LIST OF INTERVIEWEES

Name	Affiliation	Summary Lead
Blair, Tim	Metropolitan Water District of Southern California	Not For Attribution
Boardman, Tom	SLDMWA (San Luis-Delta Mendota)	Boardman
Bourez, Walter	MBK Engineers	Bourez
Briggs, David	Contra Costa Water District	Denton
Brown, Paul	Camp, Dresser & McKee	P. Brown
Brown, Russ	Jones and Stokes	R. Brown
Chan, Grace	Metropolitan Water District of Southern California	Chan
Davis, Martha	Inland Empire Water District	Davis
Denton, Richard	Contra Costa Water District	Denton
Dvorak, Allison	SWRI, Inc.	Link
Erlewine, Terry	State Water Contractors	Erlewine
Fock, Anna	Montgomery Watson Harza	Sun
Fryer, Lloyd	Kern County Water Authority	Fryer
Fullerton, David	Metropolitan Water District of Southern California	Fullerton
Grinnell, Steve	Montgomery Watson Harza	Grinnell
Herbold, Bruce	USEPA	Herbold
Hilts, Derek	USFWS	Hilts
Hutton, Paul	Metropolitan Water District of Southern California	Fullerton
Joyce, Brian	National Heritage Institute	Purkey
Kao, Cindy	SCVWD	Maher
Kirby, Ken	SKS Water Management	Kirby
Leaf, Rob	CH2M-Hill	Not For Attribution
Lima, Joe	Modesto Irrigation District	Not For Attribution
Link, Buzz	SWRI, Inc.	Link
Maher, Joan	SCVWD	Maher
Meyer, Harold	Hydrologics	Meyer
Meyer, Jeff	Hydrologics	Meyer
Miller, BJ	Consultant	Miller
Munevar, Armin	CH2M-Hill	Munevar
O'Connor, Dennis	State Senate Agriculture and Water Committee	O'Connor
Orlof, Leah	Contra Costa Water District	Orlof
Pahuja, Sanjay	CH2M-Hill	Not For Attribution
Paul, Duane	Northwest Economic Associates	Paul
Purkey, David	National Heritage Institute	Purkey
Quimby, Jeff	Contra Costa Water District	Quimby
Rosekrans, Spreck	Environmental Defense Fund	Rosekrans
Satkowski, Richard	State Water Resources Control Board	Satkowski
Schuster, Dave	SWRI, Inc.	Not For Attribution
Sheer, Dan	Hydrologics	Sheer
Shum, KT	East Bay Municipal Utility District	Shum
Smith, Bill	SWRI, Inc.	Link
Snow, Jim	Westlands Water District	Snow
Spivy-Weber, Frances	Mono Lake Committee	Spivy-Weber
Steiner, Ban	Consultant	Steiner
Sun, Yung-Hsin	Montgomery Watson Harza	Sun
Tull, Rob	CH2M-Hill	Tull
Tustisen, Ben	MBK Engineers	Bourez

Upadhyay, Deven	Metropolitan Water District of Southern California	Upadhyay
Van Lienden, Brian	SKS Water Management	Williamson
Vorster, Peter	Bay Institute	Vorster
Wang, Chuchang	Metropolitan Water District of Southern California	Wang
Wilkinson, Robert	UCSB	Wilkinson
Williamson, Mark	SKS Water Management	Williamson

APPENDIX C: CONTACTED BUT NOT INTERVIEWED

Name	Affiliation
Andrews, Betty	Phil Williams & Assoc.
Gartrell, Greg	Contra Costa Water District
Gleick, Peter	Bay Institute
Jones, Craig	State Water Contractors
Najmus, Saquib	WRIME
Yale, Carolyn	USEPA

APPENDIX D: GLOSSARY AND ACRONYMS

This appendix contains the glossary and acronym list for those terms used by the interviewees. Sources are denoted by parenthesis ().

(AFRP) – USFW Anadromous Fish Restoration Program. Available at: http://www.delta.dfg.ca.gov/afrp/acronyms.asp.

(CALFED, 1999) - CALFED Bay-Delta Program - Integrated Storage Investigation - March 16, 1999. Available at: http://calwater.ca.gov/Archives/Storage/IntegreationStorageInvestigation_March99.shtml

(DWR, 2002a) – "State Water Project Reliability Report", 2002.

(DWR, 2002b) – "CALSIM Water Resources Simulation Model", September 30, 2002. Available at: http://modeling.water.ca.gov/hydro/model/description.html

(Hutton, 2001) – "Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh: 22nd Annual Progress Report, Chapter 8", August 2001. Available at: http://modeling.water.ca.gov/delta/reports/annrpt/2001/2001Ch8.pdf

(USBR, 1994) - "Central Valley Project Improvement Act Programmatic Environmental Impact Statement, Phase II, Analytical Tools Report", April 1, 1994.

(USBR, 2003) – "Water Acquisition Program: Program Information, Glossary", September 18, 2003. Available at: http://www.usbr.gov/mp/cvpia/wap/docs/glossary.pdf

ANN – Artificial Neural Network

Article 21 – Contracts that permit the delivery of water to state water contractors above the amounts in Table A under specific conditions. The conditions are:

1. "It is available only when it does not interfere with SWP allocations;
2. It is available only when excess water is available in the Delta;
3. It is available only when conveyance capacity is not being used for SWP purposes or scheduled SWP deliveries; and
4. It cannot be stored within the SWP system. In other words, the contractors must be able to use the Article 21 water directly or store it in their own system." (DWR, 2002a)

(b)(2) – Section 3406(b)(2) of the CVPIA (Public Law 102-575) states:

> "[U]pon enactment of this title [Title 34] dedicate and manage annually 800,000 acre-feet of Central Valley Project yield for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this title; to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and to help meet such obligations as may be legally imposed upon the Central Valley Project under state or federal law following the date of enactment of this title, including but not limited to additional obligations under the federal Endangered Species Act."

Bay Delta Accords – The 1994 agreement that created the framework for the CALFED Bay-Delta Program.

Bulletin 160 – California Water Plan Update; a document that the Department of Water Resources is required by law (reference) to publish every five years.

CALAG – California Agricultural Model – "CALAG is a mathematical programming model that simulates farming decisions by growers. It estimates future crop acreage based on maximizing profits subject to resources, technical and market constraints. It includes 26 crops and 46 regions covering the entire state of California." (AFRP)

CALFED – "A cooperative effort involving several state and federal agencies with management and regulatory responsibilities in the San Francisco Bay/Sacramento-San Joaquin Delta estuary (the Bay-Delta). State agencies include the Department of Water Resources, the Department of Fish and Game, the California Environmental Protection Agency, and the State Water Resources Control Board. Federal agencies include [the United States Bureau of] Reclamation, the [United States Fish and Wildlife] Service, the US Environmental Protection Agency, and the National Marine Fisheries Service." (USBR, 2003)

CALFED ROD – CALFED Record of Decision

CALSIM – California Simulation Model – "CALSIM is a generalized water resources simulation model for evaluating operational alternatives of large, complex river basins. Developed by the Department of Water Resources, CALSIM integrates a simulation language for flexible operational criteria specification, a linear programming solver for efficient water allocation decisions, and graphics capabilities for ease of use. These combined capabilities provide a comprehensive and powerful modeling tool for water resource systems simulation." (DWR, 2002b)

CALSIM II – The application of CALSIM to the State Water Project and Central Valley Project.

California Water and Environmental Modeling Forum – an organization of water modelers for California (www.cwemf.org)

CALVIN – California Value Integrated Network – an economic-engineering optimization model of California's inter-tied water system developed at the University of California Davis.

Carriage Water – "Carriage water may be defined as the extra water necessary to carry a unit of water across the Delta for export while maintaining all agricultural and M&I water quality standards in the Delta. This "traditional" carriage water definition evolved from the D-1485 regulatory environment and applies to conditions when water quality standards are in danger of being violated." (Hutton, 2001)

CART - CALSIM ANN (Artificial Neural Network) Refinement Team

CEQA – California Environmental Quality Act – the legislation that requires that an EIS be prepared for project authorization.

COA – Coordinated Operations Agreement

CSDIFF – A file-difference analysis tool used by DWR to track changes made between CALSIM II versions.

CVGSM – Central Valley Ground-Surface Water Model – "a water supply model. It simulates monthly water distribution/movement throughout the entire Central Valley floor." (AFRP)

CVP – Central Valley Project – "a federally funded and constructed series of dams and waterways to promote agriculture in California's Central Valley." (AFRP)

CVPM – Central Valley Production Model – "the Central Valley Production model is an economic model that accounts for crop production costs in different areas of the Sacramento and San Joaquin valleys in conjunction with the effect of overall production levels on the market prices for California crops." (ARFP)

CCWD – Contra Costa Water District

Consumptive Use Model - Central Valley Consumptive Use Model – DWR model of Central Valley agricultural water and land use.

D-1485 – SWRCB Decision D-1485 (1978) – the decision establishing water quality standards, definitions of protected beneficial uses and amending DWR and USBR's water rights pertaining to the Delta by regulating the operations of the SWP and CVP. (Available at: http://www.waterrights.ca.gov/hearings/Decisions.htm)

D-1641 - SWRCB Decision D-1641 (1999) - implementation of water quality objectives for the San Francisco Bay/Sacramento-San Joaquin Delta; petition to change the points of diversion for the Central Valley Project and State Water Project in the southern delta; petition for change in place of use and purpose of use of the Central Valley project. Ruling was modified in 2000. (Available at: http://www.waterrights.ca.gov/hearings/Decisions.htm)

D-1644 - SWRCB Decision D-1644 (2001) - Decision regarding protection of fishery resources and other issues relating to diversion and use of water from the lower Yuba River. It was subsequently vacated and revised. (Available at: http://www.waterrights.ca.gov/hearings/Decisions.htm)

Dongel – A piece of hardware required to run XA Solver.

DSM2 – Delta Simulation Model 2

DSS – Data Storage System (HEC-DSS, developed by US Army Corps of Engineers).

DWR – California Department of Water Resources

DWRSIM – Department of Water Resources Simulation Model – "the main computer model developed and used in the Hydrology and Operations section of the California Department of Water Resources is the DWRSIM model. DWRSIM is a monthly time step, reservoir system simulation model of the Central Valley of California." (ARFP)

EBMUD – East Bay Municipal Utilities District

EIS – Environmental Impact Statement

EIR – Environmental Impact Report

EWA – Environmental Water Account – "a California Bay Delta Authority program to obtain water for environmental uses while minimizing water supply impacts on cities, farms and businesses." (AFRP)

FERC – Federal Energy Regulatory Commission – "a U.S. federal agency that regulates the interstate transmission of natural gas, oil, and electricity and also regulates natural gas and hydropower projects." (AFRP)

FDM - Fischer Delta Model – "a deterministic hydrodynamic and salt transport model developed for the Sacramento-San Joaquin Delta. This model simulates flow and salinity variations due to changes in channel geometry, hydrologic variability, and operation of control structures in an estuarial environment." (USBR, 1994)

Freeport Project - A joint regional water supply project being developed on the Sacramento River by the Sacramento County Water Agency and EBMUD.

G-Model – Delta salinity-inflow model developed by CCWD and used in DWRSIM to estimate the Delta's flow-salinity relationships.

Gaming Exercises – Modeling exercises involving stakeholders to commonly understand and develop operational alternatives, recently applied for water operations and Delta fisheries.

GIS – Geographic Information System

GUI – Graphical User Interface

IEWD – Inland Empire Water District

IGSM – Integrated Ground-Surface Water Model – "a mathematical model that simulates groundwater flow, surface water flow, and surface-groundwater interaction. The model also calculates agricultural and urban water demands based on land use." (AFRP)

In-Delta Storage – Using Delta islands for water storage.

IRP – Integrated Resource Plan

IRPDSM – Integrated Resource Plan Distribution System Model

IRPSIM – Integrated Resources Planning Simulation

ISI – Integrated Storage Investigations – "an effort to coordinate existing storage investigations being conducted by CALFED agencies, CALFED-initiated storage evaluations and broader water management strategies and analysis to provide a comprehensive assessment of alternative storage options and their utility to overall water management." (CALFED, 1999)

KCWA – Kern County Water Agency

KCOM – Operations and planning model for KCWA.

LCPSIM - Least Cost Planning Simulation Model – "an economic model that evaluates the economic benefits and costs of increasing reliability to urban areas by evaluating the economic consequences of the yearly changes in demands and availability of water supplies." (AFRP)

LP – Linear Programming

MDO – Used in PROSIM's to estimate the Minimum Delta Outflow requirements.

MODFLOW - Modular three-dimensional finite-difference ground-water flow model maintained by the USGS.

MODSIM – Generic water resource simulation package from Colorado State University.

Monterey Agreement – A 1994 agreement between DWR and various SWP contractors that allows for more flexible operation of SWP facilities in exchange for reduced rates and increased reliability.

MWD – Metropolitan Water District of Southern California

NEPA – National Environmental Protection Act

NHI – Natural Heritage Institute

OCAP – CVP Operations Criteria and Plan

QA/QC – Quality Assurance/Quality Control

Phase 8 – The eighth phase of the Bay-Delta Water Rights Hearing, an agreement among stakeholders related to the implementation Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, which relates water rights and Delta water quality standards.

PROSIM – Central Valley Project Simulation – "a water supply model that simulates operation of SWP and CVP projects." (AFRP)

SANJASM – San Joaquin Area Simulation Model

SANTUCM – San Joaquin Tulare Conjunctive Use Model

SCVWD – Santa Clara Valley Water District

Site Reservoir – Proposed offstream reservoir near Maxwell, that would divert from the Sacramento River.

SWPOCO – State Water Project Operations and Control Office

SWRCB - State Water Resources Control Board

SWP – State Water Project

SYSMOD – Operations and planning model for SCVWD.

Table A – A listing of the state water project contractor's contracted volumes. It defines the terms and conditions govern the water delivery and costs of repayment for the SWP.

TMDL – Total Maximum Daily Load

USBR – United States Bureau of Reclamation

USEPA – United States Environmental Protection Agency

USFWS – United States Fish and Wildlife Service

VAMP - Vernalis Adaptive Management Plan - a watershed-level program for improving flow and water quality objectives on the San Joaquin River.

WRESL – Water Resources Simulation Language

WSI/DI – Water Supply Index/Delivery Index

XA Solver – The commercial solver used by CALSIM.

APPENDIX E: CATALOG OF COMMENTS

This appendix contains the comments from both the "for attribution" and "not for attribution" summaries categorized according to content.

MISSION

General Comments

Summary Lead	Comment Number	Comment
Fryer	9b	Because operations have become orders of magnitude more difficult over the last 20 years, it is important to have a tool that can help analyze the system quickly.
Not For Attribution	4	CALSIM II cannot meet all modeling needs. It should serve its niche well, rather than all purposes. You should not use more model than you need for a given project. For example, CALSIM II is not perfect for CVP OCAP, but there is no better model available.
Erlewine	4j	DWR over-emphasizes the importance of CALSIM II. The result is that the model is used inappropriately, mostly because it is the only tool available. There are times when using CALSIM II is not necessary, yet it is still used.
O'Connor	5b	Additionally, outside evaluation needs to be conducted (akin to an external audit report). Need a fine level review, much like an anonymous journal review. It needs to be conducted by qualified, interested people who do not have any "vested, self-interest" in the model. There should be two levels of review:
O'Connor	5b1	Is it capable of answering the questions that are asked?
O'Connor	5b2	Is it calibrated and used in a way that is reasonable?
Not For Attribution	9	There is a weakness in the way CALSIM II is formulated. CALSIM II is a policy model that is used to simulate the entire system, physical as well as regulatory/policy constraints. CALSIM II formulation is based on DWRSIM formulation. There was not much thought into what questions CALSIM should be able to answer. What is needed is a watershed model that captures the physical aspects of the system (hydrology), which would then feed into a policy model containing the policies and regulatory constraints. The ideal model would start with water supply forecast so that informed operation decisions can be made.
P Brown	4e	No matter how good a tool is, it is important to define the problem appropriately based on clear objectives before modeling even begins.
O'Connor	9b	For any model, the questions to be asked need to determined first and the tools to use, second.
Davis	3b	Bigger questions are being asked than just those concerning the Bay-Delta. DWR cannot afford to have a Delta-centric model, as it clearly cannot address current policy questions in California.
P Brown	2c	A detailed hydraulic and hydrologic model such as CALSIM II is appropriate and necessary to examine the detailed effects of specific changes in facilities and operations.
P Brown	2d	For broad-scale, planning questions, a less detailed, bigger picture model can provide "adequately precise" rule curves and guidance with which to eliminate most alternatives and focus more detailed analyses on a few good alternatives. Such a model has the benefit of incorporating other performance measures (e.g., cost, water quality, environmental impacts) in more holistic, integrated fashion.
P Brown	3a	Hopes that people do enough work on California's "plumbing" and the institutions that control it, so that detailed models such as CALSIM II will be used frequently.
P Brown	9a	As mentioned above, there are many different types of models used for different purposes. There are models well suited for strategic level decisions, tactical planning, and operations. CALSIM II represents a good model for tactical planning, that is a model to help planners and operators understand the State Water Project and CVP system under different hydrologic and operating scenarios. However, a statewide strategic level model is lacking. Such a model would be able to integrate the many facets of water resources such as supply reliability, cost, water quality, environmental impacts, and public acceptance in a more holistic and comprehensive fashion. A strategic model would compliment CALSIM II, and in many ways make it stronger as there would be less temptation to use the model for purposes other than those for which it was intended.
Tull	4r	People are now looking at CALSIM II results in individual months. CALSIM II was designed to be applied on a more planning level "statistical basis," providing information on general trends.

Not For Attribution	9	"As with any model, we need to be cautious of not putting too many features into CALSIM II." CALSIM II is quickly becoming too complex for most users and applications. If all the features are necessary, then two versions of the model should be maintained; a high end and a low end product. The low end product would allow for quick, gross analyses, while the high end would allow for more sophisticated detailed analyses.
Spivy-Weber	2b	There is a need to have a statewide perspective, but this may best be gained from a network of smaller (i.e., local and/or regional) models as well as models for water supply elements (conservation, groundwater, etc.).
Spivy-Weber	3a	It is possible that it would be less expensive and/or more effective to create a network of models (possibly including CALSIM II) to achieve the goals stated in question 2, rather than adding every feature in CALSIM II.
P Brown	3b	Having the right tools at the policy/ planning level will facilitate the detailed analyses for which CALSIM II is both needed and well-suited.
Davis	3a	The questions being asked of CALSIM II have changed since it was originally developed. It is not a good idea to use CALSIM II as a predictive tool without testing it for that purpose. The use of CALSIM II as a predictive tool makes DWR's credibility vulnerable.
Spivy-Weber	3b	It would be good if CALSIM II were "one of many references," as is the case in Southern California, rather than serving as the sole basis for planning.
Paul Brown	2b	Important to match the model to the question, rather than seeing all questions through the framework of the available model.
P Brown	4g	There is currently a "disconnect" (and sometimes distrust) between those who use coarser, policy level models vs. detailed, specific models. Both types of model should be seen as complimentary rather than mutually exclusive and competitive. The distrust that often exists between users creates unnecessary conflict similar to disagreements that existed regarding DWRSIM vs. PROSIM. This is an unnecessary and counterproductive barrier to innovative use of these tools.
Snow	5b	The real-time and seasonal operations model should be a different version of the model, using the same modeling framework, but be predictive (not comparative). There might be some advantage to being able to run the model for a few years at a time in a predictive manner.
Wilkinson	4i	The need for a good model of California's water system is critical, and so planners should be careful to consider the full range of questions and objectives that such a model might address. It is important to ask if CALSIM II is the right tool to answer these questions or if we should start again from scratch with a new model.
Wilkinson	9i	We need to be careful enough to step back from CALSIM II, and all the time, effort, and resources already spent to think about long-term needs. The need for a good model is critical. We should ask ourselves if CALSIM II is what we want to "stick with" or if we should go in a different direction and create an entirely new tool.
Not For Attribution	5	There may be a need for a "more appropriate" operations forecasting tool, possibly an enhancement to the existing spreadsheet model. There may be a "void in the toolbox" here.
Not For Attribution	4	So much has been invested in CALSIM II. Will it ever provide the answers we want? Is there anything else that can be done?
P Brown	5c	Using a good policy/planning level model could facilitate the detailed analyses for which CALSIM II is necessary. Having two tiers of models (detailed and low- resolution-but-broad) could help CALSIM II perform its intended function better and more efficiently.
P Brown	4b	It is better for detailed models to stand alone and then feed into larger models than to "wire together" many models and run them all at once for general policy purposes.

Uses of the Model

Summary Lead	Comment Number	Comment
Not For Attribution	4	Assessment of impacts to fisheries is way beyond the capability of CALSIM II. Nonetheless, CALSIM II has to be used for EIR/EIS impact analysis.
P Brown	5b	The modeling community could benefit from informed generalists who can be objective and can differentiate between applications to which a model is or is not suited. It is easy for individuals who are deeply involved and invested in a model to see all problems in terms of that model's capacity to address them, often forgetting to evaluate the suitability of applying that model to that question.
Not For Attribution	5	DWR is trying to evaluate which data and tools to use for future Bulletin-160 activities. This has implications for CALSIM II development.
Not For Attribution	4	CALSIM II is a first-order model that feeds into second-order models. There is unchecked propagation of errors, particularly in a process such as Bulletin 160, when many models are used. Bulletin 160 provides an overly rosy picture of what can happen in the future.
Not For Attribution	9	Hopefully CALSIM II will eventually be used in the Bulletin 160 process.
Tull	4s	Some people want to use CALSIM II as an operations model, some as a broader, future predictive planning tool. This represents a huge range of expectations to be met by a single tool.

Sun	9c	Too many people are trying to use CALSIM II to answer “all the questions in the universe.” No model can do that. The focus of CALSIM II should be on comparative studies, not absolute values.
Not For Attribution	9	There is a debate in the Bay-Delta office over the long-term purpose of CALSIM II. Some see CALSIM II as a model of the CVP/SWP system and are extremely cautious about any other uses. Others want CALSIM II to be a detailed model of at least the Central Valley, including local operations.
Tull	4s	Some people want to use CALSIM II as an operations model, some as a broader, future predictive planning tool. This represents a huge range of expectations to be met by a single tool.
Sun	4f	CALSIM II is a good learning tool for California water system.
P Brown	4f	Application of a model to a problem for which it is not suited can “undermine” a good tool and make it look bad. This does not mean that the tool is weak, but that it should be used appropriately.
Tull	9g	It is difficult when CALSIM II is used politically rather than as a technical tool. It is then no longer an issue of how good a technical tool it is.
Not For Attribution	9	It is not clear if the questions being asked can ever be answered with a long-term planning model. No tool can currently address all the issues in water policy. It is an overwhelming data and analysis problem.
O'Connor	5c	CALSIM II needs implementation protocols and periodic testing procedures to increase credibility among policy makers. It needs a "Good Housekeeping Seal of Approval" signed by the "right" people and dated. The implementation protocols need to include a list of uses for which CALSIM II is appropriate and a list of uses for which it should not be used.
Not For Attribution	4	The less information you have, the more conservative you are. With appropriate modifications, analyses performed with CALSIM II could help to reduce this uncertainty.
Not For Attribution	4	There is no guarantee that the system will behave the way CALSIM II simulates it, even if the same hydrology were to repeat itself. When the model is directly rule-based, such as PROSIM and DWRSIM, one could look at model results and see if they made sense. With an accounting/policy interpretation model such as CALSIM II, that is no longer possible. Under current regulatory conditions, the system cannot be simulated with a high degree of certainty.
Maher	3b	Current operations (for the many parties involved) are conservative and do not maximize efficiency and use of the system. It is possible to export more than the projects currently do, but doing so would increase risk to individual deliveries. It is important to understand these risks to move forward.
Wilkinson	4b	Both DWRSIM and PROSIM were designed for specific applications and to be used in comparative analyses. Present modeling needs and purposes have evolved over time and differ from previous modeling needs. There may still be need for comparative analysis, but he questions whether the design and architecture of CALSIM II, which is based on its predecessors, is serving the current needs and purposes such as to forecast SWP supply reliability, macro level planning decisions, Bulletin 160, and policy questions currently facing the State of California.

Model Scope

Summary Lead	Comment Number	Comment
Blair	9a	User is currently leveraging CALSIM II to the maximum possible extent. User will continue to do so and hopes that CALSIM II will continue to improve and allow for further leverage
Not For Attribution	4	Current regulatory constraints cannot be implemented in a planning model. The biological assumptions incorporated in a planning model do not capture the adaptive nature of the process. It is not just the time-step, but also the actual nature of the process. The biological assumptions that are modeled may or may not occur every year, but are modeled as if they do. It does not make sense that CALSIM II results should be used to make ESA jeopardy calls.
Tull	5c	Integration of CALSIM II and IGSM/ CVGSM would be great. However, it is necessary to understand how the groundwater/surface water interactions work before the models are joined.
Not For Attribution	5	Integration of CALSIM II with CVGSM (a distributed integrated hydrologic model) is the most important development activity. It is needed to estimate groundwater use and impacts.
Not For Attribution	5	CVGSM must be integrated into CALSIM II, or an ANN that mimics CVGSM created and implemented.
Vorster	5h	Water quality (salinity) and hydrodynamics (stage) should be added to CALSIM II, especially on the San Joaquin River, at least up to the Mendota Pool.
Maher	3c	Operating more aggressively would make it very important to understand variations in demand (e.g., high demand in late summer and early fall and their implications if storage in San Luis is low).
Not For Attribution	5	Implementation of hydropower accounting.

Upadhyay	4e	CALSIM II only looks at one level of development for the entire period of hydrologic record. MWD needs to model different hydrologies through time, as demands evolve spatially and temporally. This is especially true for looking at conveyance and treatment issues for growing inland demand areas.
Spivy-Weber	5d	Add the ability to incorporate water supplies/quality gains that go beyond best management practices. This might be done better in smaller scale models, rather than CALSIM II.
Not For Attribution	5	CALSIM II is not user-friendly. Developers need to talk to users about what they need and want in a model.
Not For Attribution	4	There are no economics in CALSIM II.
Tull	5d	Incorporation of economic models into CALSIM II would allow demands to respond to a non-static system. This might not happen in CALSIM II at all, but rather in the next generation model.
Not For Attribution	5	CALSIM II should have economic functions and/or ties to economic models.
Chan	5d	CALSIM II has variable hydrology, but assumes a static level demand and facilities, which makes it not very good at modeling the future. The ability to have time-varying demands and facilities would be beneficial for MWD's purposes, and make the model more like IRPSIM.
Not For Attribution	5	Would like to see energy costs implemented into CALSIM II.
Spivy-Weber	2c	Water quality is an important consideration when estimating water quantity available for supply. As such, the state should address water quality as part of its water supply planning.
Maher	2b	SCVWD is interested in the accuracy of CALSIM II's depiction of the expansion of Los Vaqueros, especially its representation of water quality and benefits. SCVWD would like to compare CALSIM II results against its own estimates.
Link	5a	Would like to see CALSIM II fully incorporate water temperature and hydropower objectives. The implementation of feed-back loops for temperature and hydropower would greatly reduce the need for iterations of CALSIM II.
Blair	4a	CALSIM II's greatest weakness is its use of static demands. This results in a loss of precision and detail in modeling results. Users models reflect changing infrastructure and demands over time; CALSIM II does not. As a result, the user must interpolate between CALSIM II runs reflecting different static levels of demand (e.g., 2005 and 2010) to develop a time-varied set of results to use as input for its own models. It does not fully capture the "evolutionary path" of storage that realistically reflects the process of new facilities coming online. For example, as a reservoir is added to the system, its storage may increase for each of five years while it fills. CALSIM II cannot reflect this dynamic process. It makes it difficult to look at the relationship between hydrology demands and water quality in the Delta over time.
Blair	5a	User would like to see the incorporation of a time element (e.g., dynamic demands that vary over time and in response to changing facilities) added to CALSIM II.
Upadhyay	5c	Modifications are needed to make CALSIM II move through time rather than assume a static level of development. This would make the model more compatible with modeling done at MWD.
Denton	4e	CALSIM II should be able to address questions regarding the effects of global warming and to be able to model "more realistic" future scenarios and modified hydrologies, such as those being developed by Jim Cloern (USGS).
Shum	4a	CALSIM II is currently set up to simulate CVP and SWP performance over a 73-year historical hydrology. Whether this is the most appropriate framework, particularly in light of potential climate change, requires some reflection. For example, how would the projects perform in more extreme droughts? This issue may be more significant if CALSIM II is to be used to aid in the optimization of Project operations. Two alternatives to the use of historical hydrology are designing hydrological sequences to explore the performance of the Central Valley system under stress (droughts or otherwise) and stochastic hydrology
Vorster	5b	Better linkage between CALSIM II and gaming exercises.
Vorster	5c	Updated CALSIM II runs and CALSIM II staff participation in gaming exercises.
Satkowski	5a	CALSIM II should include or somehow address water rights. A version of CALSIM II that works with or represents the California water rights system and could be used for both real time operations and planning would allow SWRCB to look at availability in different watersheds. This would be particularly valuable during droughts when SWRCB must determine who to cut off.

Consensus Model

Summary Lead	Comment Number	Comment
Not For Attribution	4	The existence of CALSIM II as a single, unified model supported by an interagency team is a good thing. The lack of a common modeling tool caused difficulties in the past.

Not For Attribution	4	The greatest strength of CALSIM II is that it is a single model, used by both agencies. We no longer need to waste time arguing (model wars) over which model is right.
Not For Attribution	4	Parties interested in modeling the CVP/SWP system have a common tool with which to work. This is a big achievement.
Not For Attribution	4	CALSIM II is a joint USBR/DWR model, which is a strength.
Not For Attribution	4	It has been a wonderful experience to work with DWR on CALSIM II. CALSIM II has promoted much positive interaction between the agencies, which allows for progress to be made much more rapidly.
Not For Attribution	4	DWR and USBR's "coequal" roles and stakes in CALSIM II give the agencies a common tool and "language," which helps in the effort to explore new and different ideas and to assemble support and buy-in for them.
Not For Attribution	9	CALSIM II really is a joint model in the way the model is being used. Technicians on both agencies have confidence in CALSIM II. There are and there will always be valid criticisms, and we will keep working on improving the model. On a technical level, CALSIM II creates a level playing field for the agencies
Not For Attribution	4	CALSIM II is a jointly developed model, making it the "obvious" choice for the CALFED analyses.
Not For Attribution	4	It is very good that USBR and DWR are working together on CALSIM II. The cooperation provides a huge benefit and has moved both agencies forward.
Williamson	4a	An improvement over previous models, CALSIM II is a joint USBR and DWR model so it has a common data set. It is the only model of the state and federal system.
Not For Attribution	4	CALSIM II was developed as a joint CVP-SWP model, but its application has stretched far beyond these concerns.
Wang	4c	It is "good" that the federal and state agencies and MWD use a standard tool to model the state and federal projects and produces more "consistent study results".
Hilts	4b	On one hand, it is efficient to have USBR and DWR working on a single model - pooling their resources. On the other hand, the checks and balances of using competing models is lost.
Not For Attribution	4	CALSIM II is the common model for DWR and USBR for comparative analyses, which is a strength.
Fullerton	4i	Although it is a "big and clunky" model, DF believes that there is some advantage to having a single model that is used by everyone. PH agrees and adds that there is a great value in having a common state and federal model, as modeling efforts have become more productive.
Chan	4a	MWD keeps using CALSIM II because it is "probably the best framework" for the projects (CVP and SWP). It takes into account the upstream users and the Delta standards. CALSIM II has a "long history" and up until recently it has been a "consensus model."
Not For Attribution	4	CALSIM II is unique in that it is the first water allocation model that both state and federal agencies have agreed on. "CALSIM II is a critically important model."
Maher	2g	In the past, SCVWD has received differing estimates of the low point from DWR and USBR. They hope to receive more consistent projections now that both agencies are using the same model.
Wilkinson	4b	Both DWRSIM and PROSIM were designed for specific applications and to be used in comparative analyses. Present modeling needs and purposes have evolved over time and differ from previous modeling needs. There may still be need for comparative analysis, but he questions whether the design and architecture of CALSIM II, which is based on its predecessors, is serving the current needs and purposes such as to forecast SWP supply reliability, macro level planning decisions, Bulletin 160, and policy questions currently facing the State of California.

Geographic Scope and Scale

Summary Lead	Comment Number	Comment
Fullerton	5h	PH would like to see the geographic extent of the model expanded Beyond the CVP-SWP system. CALSIM II should include the Friant-Kern Canal, the Bay Area, and better representation of the Southern California system.
Sun	5e	The Friant Unit should be included in the next public release of CALSIM II.
Not For Attribution	5	CALSIM II would be more useful if it became a statewide model that included the Colorado River, for instance.
Vorster	5a	Expansion of CALSIM II to include the Tulare Basin, so coordinated operations of the Tulare Basin and other parts of the system can be simulated.
Not For Attribution	4	Statewide coverage is needed, particularly the Tulare Basin.
Not For Attribution	4	CALSIM II should include the Tulare Basin.
Sun	5f	The operation of upper basins needs to be fully implemented in CALSIM II. Pre-operation of these basins, results in major problems.

R Brown	4g	The Yuba River system is not represented in CALSIM II, so the potential for water transfers cannot be evaluated directly.
Miller	4b	The geographical extend of CALSIM II is too limited to accurately analyze options available within California. Specifically CALSIM II does not include MWD's link to East San Joaquin reservoirs, the Friant-Kern and Madera canals, Millerton, and details regarding the Bay Area. Users should not have to "shoehorn" in these features/geographic aspects into the analysis. He is also concerned that the Colorado River is not included in the geographic extend of CALSIM II.
Spivy-Weber	4c	CALSIM II, as I understand it, does not represent local projects that contribute to the supply system. These include groundwater conjunctive use in Southern California, recycled water, dynamic representation of conservation, desalination of brackish water, etc.
Wilkinson	4f	Both the CALSIM II model and the associated data coverage should be extended to include the area south of the Tehachapis. CALSIM II does not address stormwater capture, groundwater, water use, etc. in southern California.
Not For Attribution	4	For reservoirs that have upstream regulation, upstream reservoirs should be incorporated in CALSIM II (e.g., upper American River).
Vorster	4c	Tulare Basin hydrology, reservoir operations, and water demands must be included in CALSIM II to make it more useful.
Miller	5a	CALSIM II developers need to look into local and regional plans for different parts of the state (examples could include MWD, East Side San Joaquin Valley, and the Bay Area) to see what options the various water agencies are considering and to determine if CALSIM II is capable of modeling these options. If CALSIM II is unable to model these options then either an iterative post-process analysis is needed or developers need to start over and create a new model
Maher	2h	SCVWD loses significant system efficiency because it is unable to predict joint operations of the CVP and SWP and their effects on deliveries to the district.
Maher	3a	JM looks forward to the time when CALSIM II is refined to a level of accuracy and flexibility so that it can be used to understand operational risks associated with increasing combined CVP/SWP exports.
Davis	5d	The SWP needs a Delta-centric model, but for broader California water policy a better set of models is needed to show how state, regional, and local facilities and options best go together.
Davis	5e	The question is: How do local, regional, and state facilities and options best go together? We need information, data, and systems at all scales.
Not For Attribution	5	A finer spatial scale for CALSIM II should be considered.
Not For Attribution	5	Any modification of the CALSIM II model to make it applicable to the watershed level users would likely require assistance from DWR and USBR.
Not For Attribution	4	CALSIM II is an operations model for current situations, mainly focusing on the SWP and CVP systems. The model could have more potential for use if it were simplified to be used at the watershed level.
Not For Attribution	4	Some of the input data needs improvement. There is a fair amount of geographic lumping of data in CALISM II. A finer geographic resolution is needed, but it is important that consistent data is used.
Not For Attribution	4	CALSIM II is the model with the most extensive geographical coverage.
Spivy-Weber	4b	CALSIM II is, however, too focused on the SWP, to the extent that it does not do justice to the rest of the "quite huge" water supply picture.
Spivy-Weber	2a	Greatest need is for state's modeling efforts to include recycling, conjunctive use, conservation, the Colorado River and Los Angeles Aqueducts, and other supplies —local, regional, and statewide — that are "alternatives" to the SWP.
Maher	2e	SCVWD needs to be able to predict the decisions that determine operation of the groundwater banks (i.e., CVP and SWP allocations). By banking groundwater, SCVWD is buying an exchange right, and so it is important to be able to predict what they are buying.
Purkey	4a	CALSIM II's greatest strength is that it represents the entire Central Valley system. "Finally everything is in one package."
Not For Attribution	4	One of the greatest weaknesses of CALSIM II and its predecessors is institutional, from the origin CALSIM II as a model of the CVP and SWP systems. This original purpose has limited the use of CALSIM II and made its use for overall management of California water resources difficult. This origin also creates the perception that CALSIM II appears slanted toward CVP and SWP. For instance, CALSIM II is not well suited to look at changes in rim hydrology.
Not For Attribution	4	Expectations of CALSIM II are too high. CALSIM II is a model of the CVP/SWP, not a statewide planning model.
Not For Attribution	4	CALSIM II does a good job at representing the water resources system of the Central Valley (not including the Tulare Basin which is not modeled directly at this time), including hydrological and institutional constraints and representation of all the major projects. The long period of record allows for statistical analysis of impact of proposed projects when used in comparative mode.

Other

Summary Lead	Comment Number	Comment
Paul	9a	DWR is far ahead of other states in the development of analysis tool. He has great respect for DWR modeling efforts.
Spivy-Weber	9b	The Legislature might be more supportive of funding for modeling if the subject were made less intimidating.
Tull	4q	Recent applications of CALSIM II have drawn close scrutiny due to litigation, which has led to a better understanding of the model and the parameters that drive results .
Not For Attribution	4	It is good that CALSIM II is publicly available.
Not For Attribution	5	A major change is occurring in water planning in California. Regional authorities are taking more responsibility and DWR must adapt its services for this change. A data clearinghouse function is useful for examining interaction and impacts of regional activities.
Erlewine	9a	There is generally no policy demand for modeling. To suggest modeling is often seen as a "stall" tactic.
Davis	9a	It is extraordinary how poor our understanding is of California water, groundwater, water quality, etc.
Davis	2c	Expects lawsuits testing the basis for findings of adequate water supply. “Paper water” is not a good enough basis for development to go forward. Additional model scrutiny is anticipated as a consequence of using loose numbers in water supply and availability forecasts.
Davis	3c	Tighter numbers are now important and will become more important for compliance with legislative requirements to assure water availability for new land development. There is now a clear nexus between water availability and land development. It must be possible to defend water availability calculations against legal challenges.
Sheer	4e	DWR has felt compelled to simulate the system as it exists. The effort would have been much better spent trying to find better operating rules. California needs to focus more on performance for beneficial uses than on “who gets what.”
Sheer	4h	The concept of CALSIM II is right and very similar to OASIS. Implementation of this concept is somewhat different between these two models.

ADMINISTRATION

Support

Summary Lead	Comment Number	Comment
Not For Attribution	4	WRESL was designed to make CALSIM modeling more transparent, but the model requires hundreds of input files. This has frustrated and inhibited many potential users and given people on the “outside” the impression that CALSIM modeling is a “closed shop”.
Wang	9b	Expand the professional support base.
Not For Attribution	9	There is a need to, at least, double the number of model users who can run the model.
Not For Attribution	9	The wider CALSIM II user community is a big step forward beyond DWRSIM, where very few people could run and interpret model results.
O'Connor	9a	People who rely on CALSIM II the most might not even know it exists. There is a lack people who understand both modeling and policy.
Hilts	4h	As with most other large models, there are a few "insiders" who understand the intimate details of the model and many "outsiders" who never will and don't want to. If there are more CALSIM II insiders than there were for DWRSIM and PROSIM, that would be a strength.
Upadhyay	4c	Getting a new model run from DWR is a very lengthy process. MWD must often make decisions in a shorter time frame. CALSIM II runs are generally just one component in a study, but are necessary, so delays from DWR hold up the entire process. MWD may need to create a "CALSIM II simulator" to enable them to perform their studies in a timelier manner.
Not For Attribution	5	He would like to expand the support base far beyond the agencies (DWR and USBR).
Not For Attribution	5	It would be good to have more staff to run CALSIM II.
Kirby	5d	DWR and USBR would benefit from expanding (or broadening) the knowledge base. Stakeholders need someone they trust to run the model. This could be accomplished through training, better documentation, and hands-on experience.
Kirby	5d2	An apprenticeship-type program is needed if the criteria for what makes a good study cannot be written down. Or a standing review group that supports and certifies studies

		done by others could be helpful.
Kirby	5e	Software to compare changes in CALSIM II input is needed to reduce the burden on the few individuals of the "inside."
Kirby	5e	Software to compare changes in CALSIM II input is needed to reduce the burden on the few individuals of the "inside."
Maher	5c	Few people are competent to use CALSIM II, which is "almost dangerous" given the number of people who rely on the model. It is important to make knowledge of CALSIM II as widespread as possible.
Meyer	9b	Has heard that "few people used DWRSIM and fewer people are using CALSIM II." This could be a function of the additional difficulties facing California water management (EWA, (b)(2), ESA) modeling.
Not For Attribution	4	CALSIM II is still so new that there are not enough experienced users, although this number is growing.
Not For Attribution	5	More skilled CALSIM II users. Hopefully this would result in greater competition for contracts to complete analyses that require CALSIM II.
Not For Attribution	4	CALSIM II is becoming rather complicated, with only a small pool of people that understand the model enough to make changes. We are going back to the same problem that we had with PROSIM and DWRSIM, where only very few people were proficient enough to work with the model.
Not For Attribution	4	CALSIM II is becoming rather complicated, with only a small pool of people that understand the model enough to make changes. We are going back to the same problem that we had with PROSIM and DWRSIM, where only very few people were proficient enough to work with the model.
Purkey	9b	The real power of CALSIM II will be realized when the user community broadens beyond the agencies and consulting firms and when other groups can use it independently.
Not For Attribution	4	The number of experienced users of CALSIM II is very small. Although it will take time to expand this group, it will be increasingly important to do so as the volume of work requiring CALSIM II runs increases.
Not For Attribution	5	An "army of people" who know how to run CALSIM II would help. There are only so many knowledgeable people around. Given the need to conduct model runs, they cannot spare the people who are still working on model development. A backlog of studies needing CALSIM II runs has already built up.
Rosenkranz	4a	CALSIM II's learning curve is too steep. Cannot run the model despite having taken the training class. Used to run DWRSIM, but CALSIM II is too hard to modify and run. Does not know where to begin to modify capacities, rule curves, etc. CALSIM II was designed to be easier to use. However, it is now much more complex and harder to use than its predecessors.
Rosenkranz	5c	If CALSIM II is not easy enough to use that it can be run locally, then would like to have DWR do free runs in a timely manner.
Boardman	4c	There are very few people that can run CALSIM II with reliable results. The pool of consultants that use CALSIM II is very small. With a large number of stakeholders, the potential for conflict of interest is large.
Not For Attribution	4	There is no lead person for CALSIM II who shepherds all CALSIM II efforts. There is no central location where development information is kept. This has been the source of many of the problems with CALSIM II.
Meyer	5b	Better support for users outside of the agencies is needed.
Not For Attribution	4	Commercial competition between consulting firms that work with CALSIM II provides disincentives for them to be forthcoming with information about and assistance with the model. Ability to use CALSIM II has become somewhat proprietary knowledge held by a few competing firms. This has restricted the flow of insight regarding CALSIM II to other parties.
Purkey	4m	There is no individual assigned to provide support to users of CALSIM II. When questions are sent to knowledgeable individuals, they often go unanswered. This issue is of particular importance to non-agency, non-consultant groups such as NHI who are not affiliated with existing sources of knowledge and support for the model.
Tull	5f	Somebody needs to take on the task of providing user support for CALSIM II.
Grinnell	5b	It would be helpful if there were a "help desk" where users can go for information regarding the model. This includes help on current coding, WRESL language, node connectivity and assumptions regarding operating rules.
Not For Attribution	4	This group is fairly pro-CALSIM II because they have had good technical support.
Boardman	5c	Easily accessible technical support.
Miller	9a	"It would be great if someone like me could use the model." He feels that it would be useful to have a user-friendly website where he could go with confidence and find answers to some typical questions. This website would also contain the results from "typical" model runs for some of the more "common" questions.
Fullerton	5m	PH suggests that a web utility for users so that data can be easily downloaded and statistical analysis on results can be performed.

Vorster	5i	There should be on-line tutorials for CALSIM II, both for model users, as well as users of model results. Not everybody who would like to understand the model and its results can attend workshops.
Not For Attribution	5	Taking full advantage of current and emerging technologies: for example training on the web for new CALSIM II users.
Wang	9a	Provide and enhance the training program.
Spivy-Weber	9a	CALFED Science Program should run a workshop for legislative staff and other consumers of CALSIM II who are not modelers after the peer review is completed.
Not For Attribution	4	DWR has done a good job in CALSIM II training and public outreach. Although this is not the primary focus, it is important for moving plans forward.
Fryer	5a	It would be ideal if DWR could hold fairly intensive training classes. SWP contractors would like to be able to perform CALSIM II studies themselves.
Maher	5a	Training courses seem to be spaced far apart and based on demand. Good training opportunities would be helpful.
Tull	4v	A two-day training class is not sufficient to learn how to use CALSIM II. There is too much of both the model and the physical system to learn. Current workshops focus on running CALSIM II, rather than on understanding its results.
Tull	5h	A mechanism is needed to bring non-modeling people to an adequate level of comfort with CALSIM II. Such a mechanism would include conveying the model's complexities and helping people develop reasonable expectations of how they can use CALSIM II.
Not For Attribution	4	CALSIM II users need more guidance. Public agencies are generally not geared to provide training like private software developers.
Not For Attribution	5	More training is needed on CALSIM II.
Williamson	5a	DWR needs to consider investing more money and resources into training new users. This could be an allocation of resources problem.
Not For Attribution	5	A users' group is needed to overcome the impression that CALSIM II is a "closed shop."
Wang	9d	Activate a user group to share CALSIM II development and application issues.
Not For Attribution	4	The formation of an informal users group is positive.
Upadhyay	5b	There should be a technically focused user group and forum both for training and development. This forum needs to be well structured and not just a place to voice complaints. It needs to have technical people involved that can provide and help develop solutions/suggestions to issues of concern.
Not For Attribution	5	A users group would be a good way to spread the knowledge and understanding of CALSIM II to users outside the agencies.
Not For Attribution	9	Very few people outside DWR and Reclamation take advantage of the bi-weekly coordination meetings.
Fullerton	5n	PH also suggests the creation of a users group, perhaps through the modeling forum.
Chan	9a	DWR should have a user group (that meets relatively infrequently, once a year perhaps) to exchange ideas on how to use the model and what improvements are needed.
Orloff	5a	Both LO and JQ would appreciate the creation of a CALSIM II users' group to bring experts and new users of CALSIM II together, possibly through a monthly meeting, to facilitate education regarding the model.
Purkey	5c	A user board to which to post questions would be useful.
Satkowski	5b	A user group for CALSIM II so that users could exchange information about, support for, and improvements to CALSIM II.
Tull	5g	CALSIM II needs something equivalent to the user support group that exists for IGSM.
Not For Attribution	9	CALSIM II is a good model. A users group is needed to facilitate appropriate use and understanding, and to informally talk about common problems and solutions. Unresolved issues can be brought to CALSIM II developers. There is only so much DWR can do. Confidence would improve if people share problems and successes.
Not For Attribution	5	A user group for agency (DWR and USBR) staff who run CALSIM II in association with various decision support activities could provide a forum for questions and answers between users of CALSIM II. This could take the form of a simple email list. .
Williamson	5c	A CALSIM II user group is needed for training new users and providing a forum for discussing various issues. It would help to dispel the perception of a "closed shop."
Not For Attribution	9	Amazed at the culture that has developed around CALSIM II. Training people outside of DWR and communicating what CALSIM II does and the value of the results requires management. These "public outreach" efforts are an important component to DWR's computer simulation programs…in addition to conductin model runs and developing the models
Fryer	4f	Guidance on how to use the model is poor.
Not For Attribution	4	User support and documentation are very good, but can also be enhanced given the necessary resources.
Wilkinson	5b	There should be a stakeholder group to examine data on both groundwater and surface water and to determine where data are good, what needs work, and what kinds of work

	are necessary. This issue is larger than just CALSIM II.

Documentation

Summary Lead	Comment Number	Comment
Not For Attribution	4	Documentation of code and input data has been weak because it was based on DWRSIM that had some weak documentation of input data and operational rules. The CALSIM II documentation group is currently working to improve documentation.
Fryer	5b	Understandable documentation (in the form of a DWR bulletin) on CALSIM II input data and operations rules, including the decision logic is needed.
R Brown	4h	CALSIM II model results alone are not sufficient to document modeling; the entire input structure is needed to see what assumptions were made.
R Brown	4n	There is a lack of documentation on the required input files. There are many input files required for a CALSIM II run, but not all of the files have documentation.
Not For Attribution	4	There is no centralized location where the calculation files are stored (i.e., no centralized archive for detailed background documentation and calculations).
O'Connor	4e	CALSIM II assumptions are not documented in a way that policy-makers would understand. The detailed assumptions are documented at a very technical level, without any explanation of how that relates to high-level assumptions. This creates a high potential for miscommunication between the policy maker and the technical staff.
O'Connor	4h	As a consequence of the complexity of CALSIM II, the model's assumptions are not well documented. Perhaps the model is too big to be well documented.
Kirby	5c	Better documentation is needed. Create help documents to raise awareness of assumptions in the conceptual models.
Vorster	5k	Key assumptions in CALSIM II model and runs must be clearly spelled out so that CALSIM II is not viewed as a “black box”.
Purkey	4h	DP and BJ have encountered many built-in assumptions (e.g., 25 percent yield for groundwater storage) for which there are no explanations or sources. There is no documentation of the basis for these assumptions, but they can have a profound impact on results.
Purkey	4i	There seem to be many assumptions built into the WRESL code. Including these rules in the benchmark study will make it difficult to make comparisons with some model runs for which these assumptions must be relaxed (e.g., adjusting the delivery-carryover curve as a part of reservoir reoperation in coordination with conjunctive use management).
Williamson	5e	DWR needs to develop meta-data and documentation and continue to maintain it in the future.
Not For Attribution	4	CALSIM II has poor documentation, but this is being worked on.
Bourez	4j	Most CALSIM II documentation is in a few people’s heads. Work is currently being done to improve the documentation.
Bourez	4j	Most CALSIM II documentation is in a few people’s heads. Work is currently being done to improve the documentation.
Not For Attribution	4	There is very little in terms of user guidance and model documentation. For instance, what is labeled as Delta surplus is not really Delta surplus (there is no documentation to let the model user know that). Delta surplus has to be calculated from other model outputs.
Hilts	4g	The major efforts to document CALSIM II and provide training courses are strengths. It is a very good idea to broaden the user base.
Upadhyay	5a	More outreach is needed. A general summary of where the model is now and what is being done needs to be sent out to interested individuals. An email newsletter could do this.
Not For Attribution	4	CALSIM II lacks comprehensive documentation for methodology, inputs, and model logic.
Not For Attribution	5	More documentation on how to set up CALSIM II weight structure.
Kirby	4b	The conceptual model is often not well documented or commonly understood (e.g., land use changes affect the hydrology; assumptions behind the representation of the EWA, etc.).
Not For Attribution	5	Better documentation and version control
Link	4c	There is very little documentation on the model itself and on inputs and outputs. Delta surplus outflow is not what is reported as Delta surplus outflow in DSS output.
Link	5c	Model documentation needs to be improved.
Maher	5b	More online documentation of what CALSIM II can and cannot do and how its components relate to each other (e.g., representation of D1641, VAMP, etc.). What can CALSIM II do well? What can it not do well?
Meyer	4i	Documentation and user support is very weak. They need a “300 page” manual just for the application alone. Expansion of the description and use of the WRESL language with specific examples would be helpful.

Meyer	5c	Much better documentation is needed.
Not For Attribution	4	Software weaknesses include: it is hard to debug, especially for infeasibilities and it can take many days to find the source of a problem; and WRESL code documentation is “hit or miss”. Portions of it are well documented while others are not.
Purkey	4e	Better documentation throughout the model would help people learn and understand it more easily. Specifically, little information is provided regarding the meaning of individual cycles and studies and the reasoning behind their placement in the sequence of the model's execution.
Purkey	5a	Better documentation of the general background of CVP and SWP operations and how they are represented in CALSIM II would be helpful to those learning the model.
Tull	4m	Documentation for CALSIM II is limited. The model’s hydrology and the ANN are in particular need of more complete documentation.
Tull	5e	CALSIM II needs more documentation throughout. The DWR/USBR documentation and review process that is currently underway is very important.
Not For Attribution	4	There is a continuing effort to document CALSIM II. This will help future users to build on CALSIM II.
Rosenkranz	4j	The documentation is not very clear. It takes a long time to figure things out, particularly for the people who do not use the model all the time. Answers to trivial question such as those listed under 4i and 4j are not easy to find.
Rosenkranz	5a	Better model documentation, including hyperlinks. Would like to be able to click on a node to obtain all the information about the node that is used in the model, including where data comes from and where to find the original calculations used to derive it.
Grinnell	4e	There is a lack of CALSIM II documentation. It requires extensive effort just to learn the basics of the model.
Not For Attribution	4	User support and documentation are very good, but can also be enhanced given the necessary resources.
Boardman	5b	CALSIM II documentation must be improved. There should be as much effort placed on documenting CALSIM II as on developing it.
Upadhyay	9a	The interview process is encouraging because it a type of outreach. It is good to identify the shortcomings of CALSIM II.
Paul	5a	To use CALSIM II, it would be necessary to study the model documentation to determine the expertise required to run the model. It would be good to have available a short (four to five page) document that describes what the model does, how to run it, etc.
Kirby	4d	There are no specific criteria to define a "good" model run. Currently only a small group of individuals "expert users" can decide if a model run is "good." This group is sometimes perceived to not be open to outside interaction and can raise the notion that they [DWR and USBR] are hiding something.
Rosenkranz	5e	Would like to see detailed documentation to all common summary output. For example, for SWP or CVP deliveries, the documentation should say where to get this output variable, what sub-variables it is the sum of, and what contracts/contractors are associated with each of the sub-variables. This minimal amount of documentation would be minimal compared to the effort that has gone into developing the model. Without it, it is more difficult to make CALSIM useful.
Munevar	4a	CALSIM II should be used in comparative mode. There is a lack of documentation that explains what type of model CALSIM II is, what it can do, and how it should be used. If CALSIM II is to be used for absolute values, then likely errors bounds should be included.
Munevar	5a	Documentation of the model is “paramount” and goes a long way toward building trust in CALSIM II results. CALSIM II should be used in comparative mode. There is a lack of documentation that explains what type of model CALSIM II is, what it can do, and how it should be used. If CALSIM II is to be used for absolute values, then likely errors bounds should be included.
Not For Attribution	4	CALSIM II lacks documentation on sensitivity of model parameters.
Shum	5i	More effort should be placed on performing sensitivity analyses of model parameters, input, and assumptions. This would allow a better understanding of CALSIM II performance. If simulation results are not close to what is expected, the underlying causes must be explained to allow proper interpretations on whether they would actually occur in real time operations.
Shum	5j	Some indications of the magnitude of uncertainties in CALSIM II results (due to the approximations and assumptions used in the model) are necessary. Two forms of model output would appear to be more appropriate than a single value that is provided in current version of CALSIM II. (1) Provide a range (rather than one single value) for each model output, with appropriate constraints. For example, Shasta storage in a certain month *m* would be given as between *a* and *b*, Oroville between *c* and *d*, …, and the total north of Delta storage in month *m* is *z*. (2) A more informative presentation of results would be in terms of statistical parameters (as averages, variances, medians, and ranges). These statistical parameters could be based on results from a number of models, each using slightly different assumptions and approximations. They could also be generated using the same model with small perturbations of model input.

Wilkinson	5a	There should be more dialog among agency modelers and CALSIM II developers regarding the derivation of inputs to CALSIM II and the use of its outputs. There is an entire cluster of interrelated models (e.g., CALAG), all of which would benefit from a discussion of limitations of each model and how these limitations affect the other models.
Wilkinson	5d	Error bands and indications of the appropriate degrees of uncertainty associated with various CALSIM II outputs would be helpful. Some outputs may merit different levels of confidence, all of which should be indicated explicitly.

Management of Model Development

Summary Lead	Comment Number	Comment
Bourez	9a	CALSIM II development is headed in the right direction, but some hurdles remain. It is important to get people to understand that it is necessary to understand the system to be able to model it with CALSIM II or any other model.
Not For Attribution	5	CALSIM II management is too defensive. This hurts the model credibility.
Tull	5i	The agencies need to listen more to feedback regarding improvements to CALSIM II. The more people are included in the review process, the better the model will be.
Not For Attribution	5	DWR and USBR should continue to be responsive to criticism and input regarding CALSIM II. It is important to continue working on and improving CALSIM II. This will be a challenge given the demands for production work.
Bourez	4a	Rather than start from scratch, initial CALSIM development concentrated on trying mimic previous models. Many of the problems with DWRSIM, PROSIM, and SANJASM were brought to CALSIM II. It has taken a while to get out of "modeling the model" mode and to start modeling the system.
Not For Attribution	4	CALSIM II formulation is based on DWRSIM formulation. Not much thought was put into developing a model that could answer the questions that face the system.
Not For Attribution	9	There is a weakness in the way CALSIM II is formulated. CALSIM II is a policy model that is used to simulate the entire system, physical as well as regulatory/policy constraints. CALSIM II formulation is based on DWRSIM formulation. There was not much thought into what questions CALSIM should be able to answer. What is needed is a watershed model that captures the physical aspects of the system (hydrology), which would then feed into a policy model containing the policies and regulatory constraints. The ideal model would start with water supply forecast so that informed operation decisions can be made.
Link	9a	CALSIM II could have been a lot more than it is today. CALSIM II would have been a better product if developers had been focused on what needed to be done rather than replicating DWRSIM.
Meyer	4f	It seems that CALSIM II uses a lot of the old DWRSIM logic and does not take advantage of the new software capabilities.
Not For Attribution	4	DWRSIM and PROSIM were both "pure simulation" models. CALSIM II, on the other hand, is not a pure "simulation model"; it is an "interpreted policy" model. CALSIM II attempts to model policy decisions in addition to project operations. The approach of running the model for a single year four times to represent the four distinct regulatory settings makes it much harder to interpret model results.
Not For Attribution	9	Previous models were used extensively, including in the support of court decision. We were used to them and knew their strengths, weaknesses, and limitations. That understanding will take a while to develop with CALSIM II. In the meantime we need to spend much time explaining CALSIM II results to clients
Not For Attribution	9	It is essential to achieve greater integration between the modeling and the planning groups. There is a need to break down the culture dividing the modelers from planners.
Not For Attribution	5	CALSIM II needs someone who can better tie modeling to operational policy and needs (George Barnes did this).
Not For Attribution	4	It has been a wonderful experience to work with DWR on CALSIM II. CALSIM II has promoted much positive interaction between the agencies, which allows for progress to be made much more rapidly.
Meyer	4g	Communication between modelers and operators remains a problem. New modelers do not know the operations of the system and the old system operators do not know how to model.
Not For Attribution	4	CALSIM II has created a spirit of cooperation and joint ownership of the model, which is beneficial to everyone.
Sun	9a	CALSIM II is a good learning tool. Its open-source environment is a great improvement over DWRSIM and PROSIM. This is a major accomplishment, as it brings more people up to speed in terms of system operations. However, as with all models, it still needs further development.
Not For Attribution	5	CALSIM II developers are now responsive to input from DWR operations staff; however, modifications based on their input take time and CALSIM II is being updated and re-released on an almost constant basis. There is a lot of pressure on CALSIM II modelers for many studies, but there is a good rapport between this group and the model developers. "CALSIM II has decent staffing and competent people, but there are many changes and

		each change takes weeks to make."
Not For Attribution	5	More cooperation between the agencies is needed.
Not For Attribution	4	CALSIM II is so big a model that no one person understands it all. The staff structure in DWR leads to specialization, where individuals know one portion of the model very well, but do not necessarily understand other parts of the model.
Not For Attribution	5	Many of the items mentioned in #4 are being worked on
Not For Attribution	9	CALSIM II data collection is not well integrated into other offices within DWR. For example, CALSIM II development has not made use of the DPLA (Department of Planning and Local Assistance) expertise. There needs to be more willingness to open up the process, which will slow things down, but in the end it will produce a better product
Not For Attribution	4	DWR is often defensive. The defensive style is part of the problem.
Not For Attribution	9	Overall, feels bad about the controversy surrounding CALSIM II. There is no management oversight of the model at a level higher than Francis at DWR or at USBR. There have been no modelers at higher management level since Kennedy and Potter left.
O'Connor	5d	There is an overall communication problem with DWR support staff. The department does not answer the questions and concerns raised, but rather answers the questions and concerns for which they already have answers.
Kirby	9a	He is "fairly critical" of where modeling is today, but recognizes it is an improvement over where things were in the past. The demand for the use of models related to policy debates is growing faster than the modelers can respond, but he does think that DWR and Reclamation are being progressive and proactive to address these concerns.
Not For Attribution	9	I see the management evolving from a single person effort, jumping over the idea of a supervisor leading a team of modelers, to CALSIM management that requires a lead, looking at broad issues, who is over the supervisor and technical modeling team. This management model seems to be in place at DWR but not at Reclamation.
Davis	5c	Because so much work has been done with CALSIM II, there is reluctance to admit that there is a problem with the model. Conclusions seem unhedged and sometimes strain credulity. We need to determine and state what is working and what is not working so that we can move forward and justify resource expenditures for improvements. We need to "commit truth" when problems are evident.
Tull	9a	CALSIM II is a good and reasonable tool. Results are meaningful if they are applied carefully. DWR and USBR deserve a lot of credit for working hard to make CALSIM II the best tool possible. It is "almost an impossible task" to make everyone happy.
Sun	9d	Planning should lead model development. Model is a supporting tool only.
Not For Attribution	4	There is lack of output data organization in CALSIM II, as well as lack of direction within development staff at DWR.
Tull	9c	CALSIM II has a lifespan of five or six years until it will be time to move on to the next tool. The model's overhead will get to be too much and it will need a new foundation. It is time to start thinking about this now, although time and money are not available for such a creative process. It is important to think about what we will need and what questions will be asked 10 years from now.
Not For Attribution	5	Stakeholders, consultants, research groups, and universities have taken hold of the code and have worked on improving various aspects of the model.
Not For Attribution	5	He would like to see a CALSIM II "development group" to identify issues, prioritize, and allocate resources for additional model development. All this would be possible if we "create a community".
Not For Attribution	9	DWR should work more like a clearinghouse than a sole developer. CALSIM II development should be decentralized so that talent and resources that exist across the state can be tapped.
Chan	4c	Whenever there is a change it seems to take DWR a long time to capture the change. It is "very frustrating." An example is the Bay Delta Accords. Each time DWR modified the model, the project yield would change. This leads to a problem with credibility of the model.
Not For Attribution	5	Many procedures and processes have been instituted to keep track of CALSIM II development. Some have worked better than others.
Not For Attribution	5	The CALSIM II group could use more staff to work on integrating land use and changes in a more transparent way, such as using GIS linkages.
Not For Attribution	4	Any model can benefit from being enhanced either because of theoretical, technological, or applied considerations; it depends on the nature of the application and use of the results. As model purposes and applications change, the model needs to be continuously enhanced in addition to enhancements to better represent the system.
Meyer	9d	The people who have put CALSIM II together have done a "marvelous" job dealing with the difficulties of the system.
Not For Attribution	9	Model developers could have had a better product if they had talked to people earlier in the development process. Unfortunately, some DWR folks have been hostile to input and or comments from outsiders. Frustrated at the lost opportunity. Making the model an issue is a strategic mistake for DWR. Less time should be spent defending the model, as it only

		serves to hurt the model credibility.
Denton	5a	RD would like to see a more involvement of stakeholders in development of CALSIM II and more opportunity for training and education, including the creation of a CALSIM II users' group. Participation by DWR and Reclamation in such a user group would be essential.
Shum	9a	The agencies have been open to stakeholders input in the development process, for example in the CART process. A transparent and open process is probably the single most important aspect in building stakeholders' confidence in the model and modeling results.
Not For Attribution	5	Would like to have a "rigorous discussion" of the value of the work effort vs. value of product. The tendency to "drill down" on model details (e.g., calibration) compared to other approaches for estimating delivery reliability such as using stochastic inputs to CALSIM II. An issue would be how to communicate this more complex analysis to stakeholders
Tull	4i	Improvements to CALSIM II seem to focus on "specific areas." As a result, areas that do not receive attention fall behind and cannot support the refined areas adequately.
Hilts	4c	Because of the considerable investment in CALSIM II, it will continue to be used, even if other models are better suited to a particular task.
Link	9b	PROSIM and DWRSIM were dropped too quickly, long before CALSIM II was ready for release. This is still a problem for some uses and projects.
Maher	9a	SCVWD would like to see enough investment in both CALSIM II and related expertise so that users like the district can rely on it.
Sheer	4f	The nature of CALSIM II development and use is thus counterproductive in improving California water management. CALSIM II development is controlled by political fears of some stakeholders.
Sheer	4g	Someone needs to figure out how to get someone free to look at real water management innovation.
Wilkinson	4a	CALSIM II benefits from the fact that many good people have worked for a long time on both it and its predecessors (e.g., DWRSIM and PROSIM).
Sheer	5b	Disappointed that CALSIM II could have been a better model if it had been developed cooperatively.
Wilkinson	5a	There should be more dialog among agency modelers and CALSIM II developers regarding the derivation of inputs to CALSIM II and the use of its outputs. There is an entire cluster of interrelated models (e.g., CALAG), all of which would benefit from a discussion of limitations of each model and how these limitations affect the other models.

Credibility

Summary Lead	Comment Number	Comment
Not For Attribution	4	CALSIM II is the "best we have" for this very complex and controversial system.
Not For Attribution	4	CALSIM II is the most comprehensive analytical tool available describing the CVP and SWP system, including the layered regulatory requirements (D-1485, D-1641, B2, and EWA).
Not For Attribution	9	CALSIM II is the best available tool for evaluating California's very large and complex water supply system.
Tull	9b	The fact that CALSIM II is the best tool available is no longer enough.
Not For Attribution	9	CALSIM II is the best available tool for evaluating California's very large and complex water supply system. There is no other comparable model out there that can be used for the types of analyses that are needed for the storage investigations
Sun	4g	CALSIM II is the best model available of the CVP and SWP systems.
Not For Attribution	4	The level of detail in the inputs (e.g., hydrology, demands) for CALSIM II is an improvement over past models.
Link	9d	Despite CALSIM II problems, we are positive on the tool. CALSIM II better represents many aspects of the system. The move to CALSIM II was necessary, but the model is not there yet.
P Brown	4a	CALSIM II is a "remarkable accomplishment" that performs many functions better than any other hydrodynamic simulation model. California is fortunate to have such a tool.
Not For Attribution	9	We are very happy with the CALSIM II model. There has been much pressure to perform these studies in a short time frame. CALSIM II has worked well for us. In terms of accuracy and uncertainties, CALSIM II is better than DWRSIM.
Purkey	9a	CALSIM II is and advancement over its predecessors and does a reasonable job.
Not For Attribution	4	CALSIM II is more transparent and versatile than PROSIM was.
Not For Attribution	4	It would not have been possible to model (b)(2) accounting or EWA water using the older models. CALSIM II has already surpassed their capabilities.
Sun	4h	CALSIM II is much better than PROSIM and DWRSIM.
Sun	4k	Many of the simplifications inherited from PROSIM and DWRSIM for local operations are still in CALSIM II.
Sun	9a	CALSIM II is a good learning tool. Its open-source environment is a great improvement

		over DWRSIM and PROSIM. This is a major accomplishment, as it brings more people up to speed in terms of system operations. However, as with all models, it still needs further development.
Wang	4e	He has concerns regarding potential systematic errors in the model. A “second opinion” would be useful in such instances.
Not For Attribution	9	Much of CALSIM II is improving. Things that needed to get fixed are being fixed. CALSIM II will get there; it is just a matter of time.
O'Connor	5c	CALSIM II needs implementation protocols and periodic testing procedures to increase credibility among policy makers. It needs a "Good Housekeeping Seal of Approval" signed by the "right" people and dated. The implementation protocols need to include a list of uses for which CALSIM II is appropriate and a list of uses for which it should not be used.
Not For Attribution	9	Despite limited knowledge of CALSIM II, it still seems to be a great tool and model. It (or something like it) is needed in California to bring local information to the state level.
Not For Attribution	9	In general, models need to be as simple as possible so that the average user can understand and use the model with confidence. The most important thing for a model is that the user needs to have confidence in the model and its results. In other words, the model needs to be “user-friendly.”
Not For Attribution	9	Previous models were used extensively, including in the support of court decision. We were used to them and knew their strengths, weaknesses, and limitations. That understanding will take a while to develop with CALSIM II. In the meantime we need to spend much time explaining CALSIM II results to clients
Meyer	9c	If people understood the model, it would develop credibility and trust.
Tull	4u	CALSIM II still has some credibility issues. Some water districts still use DWRSIM because they trust and know the model. DWR’s historical verification should help with this.
Grinnell	4a	The impression is that the water community in California has not yet fully accepted CALSIM II as a valid model. This lack of wide acceptance leads to uncertainty in the utilizing the results.
Grinnell	9a	The sooner that CALSIM II gains acceptance in the water community, the sooner we can use it with confidence.
Sun	9b	CALSIM II has an “image issue”. Several people insist that, unless CALSIM II has a static benchmark study, the model cannot be used. This should not be the case for many studies.
Not For Attribution	9	CALSIM II is a failure. It does not represent reality.
Not For Attribution	4	CALSIM II still has a long way to go technically.
Fullerton	9a	DF is struck by the crudeness of the computer tools used to analyze water resources in California. Given the multi-million dollar stakes, surely more sophisticated and up-to-the task tools could be developed.
Not For Attribution	4	CALSIM II is very far from the original vision and expectation that it would be accessible to everyone.
Tull	9f	Public expectations of CALSIM II are very high, which can fuel frustration and criticism of the model.
Not For Attribution	4	“You gotta have tools. We want to see CALSIM II get better. It is a pretty useful tool in the right hands.”
Sheer	4a	If OASIS did not exist, CALSIM II would probably be best.
Sheer	5a	Make CALSIM II good enough so he does not need to maintain OASIS.

Revision and Updates

Summary Lead	Comment Number	Comment
Williamson	5g	The development of a web site that would enable users to log in (unique user identification) and obtain updates. The login would help with version control and would make reproduction of assumptions and results easier.
Hilts	4i	Another strength is that the model is beginning to stabilize, i.e., model evolution is slowing down.
Upadhyay	4b	Updates to the CALSIM II hydrologies have tended to greatly affect results for wet and dry year extremes. The loss of the Colorado River supplies has placed more focus on SWP reliability and what the worse case scenarios are. Because of the continual updating of CALSIM II the worse case scenario changes considerably, making it difficult to determine what could or would happen under adverse conditions. It is hard to go before a Board if the results of the analysis are changing.
Not For Attribution	4	CALSIM II is almost growing too fast for outsiders to keep up. It can be hard to keep up with what is going on in the model. While there were only one or two people involved in the development of DWRSIM, there are now many more people involved in the development of CALSIM II, both within and outside the agencies. A version-control software is currently being used to track changes to the model.
Chan	5c	DWR needs to spend more time on scenario analysis and less on "tinkering" because it is

		difficult to get support for scenario analysis.
Link	4p	Release of CALSIM II might have been premature, given the number and frequency of revisions and updates that have occurred.
Not For Attribution	5	All groups involved in CALSIM II development need to better document changes to CALSIM II between public releases. Better communication is needed, perhaps in the form of written bulletins, in addition to meetings
Vorster	9a	CALSIM II goes through so many changes that it is hard, if not impossible, to keep track. This process should be improved. CALSIM II is developed in a relatively more open and transparent process than any other model, which enhances its acceptability. The transparency of its development should not be diminished and should be enhanced wherever possible.
R Brown	4d	One of CALSIM II's weaknesses is its flexibility. Model users can add any feature they want, so that there can potentially be many different versions of the model being used simultaneously. And these versions seem to be "drifting apart." There is no standard (i.e., official) version of the model, even though the hydrology is now standardized.
Sun	4i	Not concerned with frequent model changes.
Williamson	4c	It is relatively easy to modify the system, but this also makes it difficult to keep track of all the changes that have been made to CALSIM II.
Williamson	4d	CALSIM II has a relatively small pool of users (i.e., experts) who can run and use the model because it is continually changing. Changes in the model are very rapid, resulting in only a few people who are "up-to-date" on CALSIM II. As a result, issues of data handling, version control and many potential studies cannot be addressed.
Williamson	4e	CALSIM II is a "creeping" model (i.e., it is constantly in a state of flux).
Williamson	4f	CALSIM II is a very complex modeling tool. It is really the only tool that can model the state and federal system, but it is not finished. DWR is continually modifying the model. Local users need to do studies soon and cannot wait for a "finished model."
Maher	4g	It is important to keep improving CALSIM II. Everyone recognizes the tools will never be perfect, but hopes for improvements.
Not For Attribution	4	Any model can benefit from being enhanced either because of theoretical, technological, or applied considerations; it depends on the nature of the application and use of the results. As model purposes and applications change, the model needs to be continuously enhanced in addition to enhancements to better represent the system.
Williamson	4h	CALSIM II needs to improve the way things are represented, but improvements need to be weighed against the need for a finished model.
Not For Attribution	4	CALSIM II has very poor version control. There are no descriptions of the changes made to the model between versions. Currently DWR is using CSDIFF to track version differences, but it is only a line-by-line text comparison program.
Not For Attribution	5	Use of good version control and documentation software and procedures. There is a need for a "stable base". However, version control is as much institutional as software.
Not For Attribution	4	CALSIM II developers have not established a protocol to document model changes. A revision control system is currently being implemented, but the process has been slow.
Not For Attribution	5	Better documentation and version control
Not For Attribution	5	Better documentation and version control
Link	4h	Models are tricky to modify, with so many input files scattered all over the place. It makes version control difficult.
Not For Attribution	9	CALSIM is very complex (as compared to PROSIM and other early models) due to the comprehensive treatment of the State Water Project and the Central Valley Project, and due to more advanced technology. Ten years ago one developer could just about keep up with PROSIM development. Now many are contributing simultaneously. Version control must be addressed much more rigorously. Quality control is more difficult because it is not possible for an individual to understand all aspects in detail. The political environment that CALSIM must be applied to is much more complex. This technical and political complexity act in concert to require a complex management.
Link	4q	Support for PROSIM and DWRSIM should have continued until most problems with CALSIM II had been fixed.

Calibration

Summary Lead	Comment Number	Comment
Davis	5b	CALSIM II results must come close to simulating historical data. What does it take to validate a model for predictive purposes? The Mono Lake model was calibrated based on 50 years of data. Historical comparison is important.
Orloff	5b	LO would like to see the continuation and completion of ongoing efforts to develop historical comparisons to establish a foundation for CALSIM II.
Vorster	5g	It would be good to test if the model is capable of simulating generalized historical operations. If so, confidence both in CALSIM II and the use of a monthly time-step would be

		increased.
R Brown	4l	CALSIM II uses the 1922-1994 time series of hydrologic inputs, but there has been no attempt to calibrate the model to historic operations in the Central Valley. The model output should match important features of the real system for recent years
R Brown	5c	The model should be validated with the last 25 years of hydrology (including running the model for 1995-2003).
Not For Attribution	4	Another weakness is that CALSIM II is not calibrated. Results do not necessarily match historic operations. This is not a problem as long as CALSIM II is used for comparative analyses only.
Fullerton	5g	DF would like to see a comparison of CALSIM II results with real operations in the last ten years. Is the model capable of representing real operations? If model results are different from real operations, why is that?
Snow	5a	If possible, CALSIM II should be calibrated for real-time and seasonal operations. CALSIM II then could replace the CVP and SWP spreadsheet models.
Snow	5c	Calibration documentation of the real-time version would be important.
Shum	9b	A comparison of CALSIM II output and logic to real time operations and operators' approach would be useful in understanding the implications of CALSIM II results. Recent work in this regard (presented at CWEMF's Asilomar conferences) are helpful. More detailed comparisons, in particular CALSIM II decisions *versus* CVP and SWP operators' decision approach, would be of great interest.
Link	4f	There are problems representing project operations to reflect real-time operations. This is a very common operator-modeler problem. For this reason, it is hard to calibrate a planning model. This is not a problem that is unique to CALSIM II.
Not For Attribution	5	Calibration of the model to real-time operations
Bourez	4n	There is no model calibration, although DWR is currently working on this.
Not For Attribution		More model verification is needed.
Chan	5a	DWR needs to do a calibration and validation exercise and publish the results.
Fryer	4g	Model calibration is a commonly heard concern, but seems to be a "distinction without a difference". Specific year differences are to be expected in this type of model. It will be hard to ever get it exact. For this reason, he would not expect to use CALSIM II for real-time operations purposes. It is a more realistic model for planning purposes and long-term reliability studies. For our purposes, CALSIM II results are adequate to analyze how well banking projects will operate over long, dry periods and how groundwater can be used to eliminate bottlenecks in the system. He believes that people are over-emphasizing the need for calibration to historical data.
Davis	4c	CALSIM II must be tested for predictive purposes. Biases must be identified and the reliability of results established. If absolute numbers appear "goofy" it is important to determine if there is a problem with the input data, the assumptions used, or the model itself.
Davis	5a	Validation of CALSIM II is required to determine whether or not there are systematic biases in the model. Most people think that CALSIM II over-predicts Delta exports.
Sun	4l	Not concerned about model calibration. As a planning model calibration is not an issue, except in very specific, local cases (e.g., Friant Unit).
Not For Attribution	4	The CALSIM II calibration/verification is a weakness. It is important to let people know that the limitations of CALSIM II and that planning models cannot be calibrated/verified in the same way as physical models.
Erlewine	4h	Questions need for or value of model. How do you calibrate an operations model for future operations that have never occurred? In most cases, your current and future operations differ from historical operations, making a comparison pointless.
Not For Attribution	4	CALSIM II has a decent track record for calibration. This should be improved further, since yield numbers (e.g., quantity of water available to SWP contractors in a given year) sometimes differ between CALSIM II and DWR operations studies. This discrepancy may be due in part to CALSIM II's lack of a time element.

Benchmark Study

Summary Lead	Comment Number	Comment
Not For Attribution	4	CALSIM II does not have a stable base case or benchmark. The original plan was to have a benchmark study that would be in-place and unchanged for a set period of time and then have users perform their studies using a common model. This did not occur.
Not For Attribution	4	The initial benchmark study was not good, but has improved over time. It is difficult, however, to work on long-term projects such as the EWA analysis when the Benchmark study and CALSIM II are always changing. It is hard to keep up with model revisions.
Link	4o	It is hard to keep track with revisions of the Benchmark Study. Frequent release of Benchmark studies interferes with ongoing analyses.
Grinnell	5a	It would be helpful if were an official, benchmark study that everyone can use posted on

		DWR's website. Currently such a study is a "moving target."
Purkey	4f	There is no defined metric against which to compare CALSIM II results. Even given the benchmark study, there is no standard for which specific parameters should be considered when comparing the results of two studies.
Sun	9b	CALSIM II has an “image issue”. Several people insist that, unless CALSIM II has a static benchmark study, the model cannot be used. This should not be the case for many studies.
Williamson	5f	DWR needs to produce a CALSIM II base case study that represents the current "state of affairs" (e.g., "base case for the next 5 years"). The benchmark study is a step toward this, because it is an agreement on system operations.
Williamson	4g	CALSIM II lacks a base case or benchmark study that is supported by DWR or other responsible agency that can be relied upon as a defensible basis for impact studied. Modelers agree that such system-wide models are not useful predictors of absolute system performance (e.g. flow will be 100 units), but rather should be used to show system changes due to model inputs (e.g. flow will increase 10 units) - this is not possible without a defensible base case that the responsible agency will stand behind.
Purkey	4g	Indicators for the performance of the benchmark are neither transparent nor transferable.
Purkey	4j	People are too committed to the details and assumptions used in the benchmark study, even in the face of legitimate questions. They feel that if you change the existing assumptions, then you can no longer use it for comparison. This makes innovation difficult, particularly regarding integration of newer facilities involving modifying existing operating rules.

IMPLEMENTATION

Mathematical Formulation

Summary Lead	Comment Number	Comment
Munevar	4d	The flow-salinity relationships in CALSIM II are an improvement over previous efforts. However, the ANN is still weak in its ability to capture the full hydrodynamics of DSM2.
Bourez	4q	The use of the ANN for salinity has been problematic. Small changes in flow in the Delta seem to trigger large change in operations.
Bourez	4q	The use of the ANN for salinity has been problematic. Small changes in flow in the Delta seem to trigger large change in operations.
Not For Attribution	4	CALSIM II has problems modeling carriage water. There have been instances where the ANN (trained on DSM2) has reported negative carriage water.
Not For Attribution	4	The ANN is going to be good, but it is not there yet.
Denton	4d	RD is interested in a better ability to model salinity-outflow requirements and noted that the existing salinity-outflow model in CALSIM II appears to need different model calibrations for different regulatory requirements (D1485, D1641, B2, EWA). ANN results are not consistent over the different regulatory scenarios. RD understood that in some cases, D1485 would cost more water than more stringent requirements, which does not make sense. He hopes that the current CART process will be able to resolve these issues.
Hilts	4e	Concerned that the outflow/salinity relationship in the ANN is being trained on modeled data (DSM2). Implementation of the ANN has periodically resulted in gross and unexpected Delta outflow requirements that are then capped rather than fundamentally fixed due to the inherent nature of ANNs.
Not For Attribution	4	An updated ANN currently under development is an improvement for representing Delta flow-salinity relationship
Fullerton	4h	PH believes that the implementation of the ANN is still in its infancy. Further improvements in the ANN representation and integration of Delta water quality should be a high priority. "A lot of improvement is still to be had".
Shum	4c	There are considerable uncertainties in ANN prediction of the flow requirements for meeting Delta water quality standards. One approach to estimate the resulting uncertainty in CALSIM II results is to maintain and support the G-Model version of CALSIM II. Having multiple versions of the model (each with a different Delta salinity relationship or different assumptions and approximations of regulatory constraints and operational priorities) would be useful in assessing uncertainties in model results.

Shum	4f	Water needs to meet Delta salinity standards are determined using an "ANN" algorithm. It appears that the current ANN routine in place could predict carriage water needs to be as large as 80% (i.e. Sacramento inflow would have to increase by 1.8 times that of an increase in export). Such a large carriage water estimate may lead CALSIM II to curtail exports and postpone to a time when Delta salinity is higher. It does not appear that large estimates of carriage water cost are consistent with results from numerical models such as DSM2 or FDM. At the same time, there are instances when ANN predicts much lower (close to zero, may even be negative in some earlier versions) carriage water cost than DSM2 and FDM. These observations are based on reviews of ANN output in CALSIM simulations of slightly different scenarios. These apparent inconsistencies could lead to large differences in DSM2 estimates of Delta salinity from CALSIM output hydrology for two very similar alternatives.
Shum	5c	There are considerable uncertainties in ANN prediction of the flow requirements for meeting Delta water quality standards. One approach to estimate the resulting uncertainty in CALSIM II results is to maintain and support the G-Model version of CALSIM II. Having multiple versions of the model (each with a different Delta salinity relationship or different assumptions and approximations of regulatory constraints and operational priorities) would be useful in assessing uncertainties in model results.
Not For Attribution	4	The water costs generated by the ANN are too high. It does not mimic DSM2 very well.
Not For Attribution	4	Additional water quality stations should be added in the ANN or G-Model.
Tull	4k	The ANN's behavior needs refinement. The ANN can only be as good as DSM2. Hopefully the CART process will help with this problem.
Not For Attribution	4j	The depiction of salinity in the Delta needs improvement. The ANN should improve results. There has been good collaboration between USBR, DWR, Contra Costa WD, MWD, and others on this area of work.
Sun	4q	The ANN module over-prescribes water needs to meet water quality standards.
Sun	5g	The ANN module needs to be improved as it over-prescribes water needs.
Not For Attribution	5	Training of the ANN for major proposed structural or operational changes in the Delta. (An example would be the evaluation of something like an isolated facility which would change the flow salinity relationship).
Boardman	4d	The ANN appears to overestimate the amount of water needed to satisfy regulatory requirements in the Delta.
Not For Attribution	4	The use of the ANN is an improvement over the MDO used in PROSIM.
Orloff	4b	LO states that carriage water estimates are important and therefore in need of validation.
Shum	5g	It is not clear if CALSIM II puts a high priority in minimizing salinity at drinking water intakes in the Delta. In the absence of an appropriate weighting for water quality considerations, CALSIM may give results with large differences in salinity at drinking water intakes for two alternatives with nearly identical performances in water supply and other measures. Whether such large differences would occur in real time operations should be addressed.
Wang	4f	The flow-salinity relationships in CALSIM II need to be improved, especially with respect to export water quality.
Not For Attribution	4	CALSIM II should either have a well-defined salinity carryover penalty or implement some form of look-ahead and rules-of-thumb reflecting real-time operator decisions
Orloff	4a	LO believes that the salinity modeling in CALSIM II requires "careful scrutiny." Water quality standards such as salinity drive many operations, and so it is very important to validate CALSIM II's representation of these characteristics.
Orloff	5c	LO would like to see the continuation and completion of the CART process to evaluate and improve salinity modeling.
Vorster	5n	There is a great interest in the public interest sector regarding X2 and salinity conditions in the Bay.
Wang	5a	Incorporate new flow-salinity relationships based on multi-component non-linear regression relationship.
Denton	4g	CCWD would like CALSIM II to include water quality, not just for purposes of meeting Delta standards, but also to capture preferences for when to export.
Shum	4g	It is not clear if CALSIM II puts a high priority in minimizing salinity at drinking water intakes in the Delta. In the absence of an appropriate weighting for water quality considerations, CALSIM may give results with large differences in salinity at drinking water intakes for two alternatives with nearly identical performances in water supply and other measures. Whether such large differences would occur in real time operations should be addressed.
Not For Attribution	5	Inclusion of additional water quality stations in the Delta.
Not For Attribution	4c	Current computation of salinity at Vernalis is weak and should be replaced with a more deterministic algorithm (see 3b and 5c).
Not For Attribution	5	Salinity algorithm at Vernalis must be replaced with one that does a better job at computing salinity in dry conditions, when the system is stressed. More monitoring is required to provide data for the implementation of such an algorithm.

Not For Attribution	4	There is poor water quality representation on the San Joaquin River in CALSIM II.
Sun	5d	The Vernalis water quality calculations require further improvement.
Bourez	4o	The groundwater representation is very weak, DWR is currently working on this overwhelming task
Bourez	4o	The groundwater representation is very weak, DWR is currently working on this overwhelming task
Not For Attribution	5	Groundwater operations in CALSIM II need further improvement.
O'Connor	4k	Has heard that CALSIM II represents groundwater basins as essentially having no physical limits (i.e., it can pump basins dry and then re-fill without any consequences). If this is true, it could create biases that would also affect comparative results.
Not For Attribution	5	Better representation of surface and groundwater interactions.
Spivy-Weber	5a	The biggest thing missing in CALSIM II is adequate information on groundwater and groundwater quality.
Not For Attribution	4	Groundwater representation and aquifer interactions must be improved
Not For Attribution	5	Groundwater representation and data.
Fullerton	5c	DF would like to see groundwater more fully integrated in CALSIM II, including programs that include groundwater substitution.
Not For Attribution	4	The groundwater representation in CALSIM II could be improved.
Not For Attribution	4	Groundwater representation in CALSIM II is very primitive. Groundwater and surface water interactions need to be better represented.
Not For Attribution	5	Improved groundwater surface water representation.
Davis	4e	Assumptions about infinite groundwater pumping are unreasonable.
P Brown	5a	California has significant geographically focused information about specific groundwater basins and has broad information about surface water across the state. It will be necessary to connect both worlds effectively for future planning.
Vorster	4b	The representation of groundwater in CALSIM II is weak and needs to be improved.
Vorster	5l	Groundwater simulated dynamically in CALSIM II. A simplified groundwater representation would be an improvement on current representation.
Purkey	4k	CALSIM II represents groundwater as a "bucket" that does not respond as an aquifer would. It is a fair representation for a systems model, but it could be improved.
Not For Attribution	4	Groundwater representation and integration is being improved.
Tull	5c	Integration of CALSIM II and IGSM/ CVGSM would be great. However, it is necessary to understand how the groundwater/surface water interactions work before the models are joined.
Not For Attribution	4	Groundwater aquifers should be represented better.
R Brown	4b	CALSIM II lacks basic groundwater representation (i.e., stream/river-shallow groundwater relationships). CVGSM attempted to determine the historic groundwater levels (in the Central Valley), but this was not included directly in CALSIM II.
Rosekranz	4g	CALSIM II lacks adequate groundwater representation, both in terms of modeling and data.
Sun	5a	Improved groundwater component.
Sun	5c	Better linkage of surface and groundwater.
Erlewine	4e	CALSIM II needs to be tied in with CVGSM, to include groundwater.
Boardman	4e	Groundwater representation might need to be improved.
Not For Attribution	5	CALSIM II should be linked to a groundwater model for use in analysis that considers conjunctive use of surface and groundwater. The San Joaquin Basin has many over-drafted regions. Accurate simulation of recharge is important.
Not For Attribution	5	CALSIM II should be able to evaluate long-term impacts of water transfers on groundwater and groundwater levels.
Maher	4b	Connections between CALSIM II and groundwater banking (specifically Kern County) are weak and will not be able to capture changes in future demands that result from banking activities.
P Brown	4c	Among detailed models in general, the interface between surface water and groundwater models tends to be weak.
Tull	4c	The CVGSM results used to characterize the groundwater/surface water interaction in the Sacramento Valley need to be refined. Characterization of return flows needs improvement. The current representation assumes that return flows occur in the same month.
Tull	9e	CALSIM II's successor should be built from land uses up, depicting real water, basin interactions, and groundwater/surface water interactions.

Not For Attribution	4	Groundwater/Surface water interactions are not being modeled as explicitly as it should be.
Not For Attribution	4	A better representation of stream-aquifer interactions is needed in CALISM II.
Not For Attribution	4	Groundwater is modeled dynamically in CALSIM II, though at a DSA level. Current and future needs will require that the resolution and methodology used to account for the surface water and groundwater interactions be modified.
Not For Attribution	5	CALSIM II should be able to evaluate long-term impacts of water transfers on groundwater and groundwater levels.
Not For Attribution	4	Groundwater and water quality are inadequately simulated in CALSIM II. A strong coupling with groundwater and water quality models is needed.
Not For Attribution	5	Coupling CALSIM II with groundwater and water quality models.
Not For Attribution	4	Setting the weights in CALSIM II LP objective can be a problem. There is no standard rigorous method to set the weights.
Munevar	4e	The weight structure is a limitation on the ease of use of CALSIM II. Because of the complex nature of the system modeled by CALSIM II, weights interact in ways that are very complex for the casual user. Assignment of weights can be very difficult and time consuming.
Bourez	4g	CALSIM II is driven by weights. Although this is a powerful tool, the user has to think in terms of LP to be able to use CALSIM II.
Wang	4g	Much experience is needed in setting the priority weights. There is no standard way to establish the weights, resulting in a trial and error process.
Not For Attribution	4	The weight structure is difficult to establish, as it is not purely hierarchical. More study is needed to determine best way to set up the weight structure.
Not For Attribution	4	The setting of weights is arbitrary. It is hard to know whether “screwy” results are a consequence of poor coding or incorrect weight specification.
Shum	4d	The use of discrete operation decision thresholds (“step functions”) in model algorithm could result in changes in model output that are large in response to much smaller changes in model input. Even though many of these differences would average out over a longer time period, month by month comparisons of two alternatives could show large “impacts” that may be a modeling artifact that is unlikely to occur in real time operations. One example is Delta Cross Channel gate operations. If one alternative has Sacramento flow above 25,000 cfs in December of a dry year, say, and another alternative below, CALSIM would have the gates closed all month in the first case and open for 16 days in the other. When Delta salinity is high, this could lead to large differences in Delta salinity in the two alternatives that may not occur in real time operations. Furthermore, the CALSIM II algorithm may not capture this salinity difference in subsequent months because of apparent low estimates of carriage water in ANN in many cases.
Tull	4l	CALSIM II still includes many step functions. Small change in input can result in large differences in output.
Williamson	4b	CALSIM II is an improvement over PROSIM. It has eliminated the "step functions."
Meyer	4c	CALSIM II has a “cycle” capability that enables the model to simulate either a portion of the system or the entire system under a specific set of assumptions and base subsequent “cycles” on the results of a previous “cycle”.
Not For Attribution	4	The recent addition of the option to re-start a CALSIM II run at any month during the year, incorporating updated data on current conditions, is an improvement.
Herbold	4a	The feedback loops between environmental conditions in the Delta and upstream operations are unsatisfactory. These feedback loops should be automatic and not require multiple manual model iterations to ensure that environmental standards are met.
Herbold	5a	Automatic feed back loops between environmental standards and upstream operations.
R Brown	4m	CALSIM II does not have a temperature module, so this important step must be done by hand afterwards. Sometimes the reservoir storage or release values must then be “adjusted” to give more acceptable temperature results. The temperature calculations should be integrated with CALSIM II.
Link	5a	Would like to see CALSIM II fully incorporate water temperature and hydropower objectives. The implementation of feed-back loops for temperature and hydropower would greatly reduce the need for iterations of CALSIM II.
Sun	4p	Return flows are computed based on surface deliveries; however, they should be based on surface water deliveries and groundwater pumping.
Not For Attribution	4	CALSIM II (and DWRSIM) does not do routing. For river systems and estuaries the lag time response is very important. For example the 5-day Shasta to Delta flow period is roughly the same length of the spring neap cycle. However, for incremental analysis the notion of routing and lags are of less importance, since they would already be “lumped” in with the other errors.
O'Connor	4i	CALSIM II represents a "clearly non-linear" system using a linear model formulation. This is a source of discomfort, although he realizes the computational difficulties of non-linear models.
Erlewine	4d	CALSIM II does not include year-to-year variation in ET (evapotransipiration).

Not For Attribution	4	CALSIM II needs better modeling of water quality issues.

Operations Representation

Summary Lead	Comment Number	Comment
Not For Attribution	4	CALSIM II is good at representing the institutional and regulatory constraints.
Not For Attribution	4	No other tool comes close to CALSIM II detailed representation of operating rules.
Not For Attribution	4	CALSIM II does a good job of detailing operating policies and environmental regulations. This strength is also a weakness, as it is almost impossible for a layperson to understand model results.
Not For Attribution	4	CALSIM II has the ability to simulate the operations (for planning purposes) of the complex rules governing the statewide operations of the SWP and CVP systems.
Not For Attribution	4a	CALSIM II's can simulate the operation (for planning purposes) of the complex rules governing the statewide operation of the SWP and CVP systems fairly well.
Not For Attribution	4	CALSIM II does a good job at representing the water resources system of the Central Valley (not including the Tulare Basin which is not modeled directly at this time), including hydrological and institutional constraints and representation of all the major projects. The long period of record allows for statistical analysis of impact of proposed projects when used in comparative mode.
Herbold	4b	CALSIM II does a very good job at representing reservoir operations and Delta exports.
Spivy-Weber	4a	I assume CALSIM II does a good job of modeling the SWP.
Not For Attribution	4	Some processes are difficult to model, such as criteria for Delta Smelt presence at the pumping plant that require that pump operations be stopped (D-1643).
Erlewine	4a	Interface between real-time operations and CALSIM II is a concern. SWP real-time guidelines are not included in the model. Some of the operational practices seem beyond the existing capabilities of CALSIM II. For many, probably most applications (especially comparative), this is probably not a problem. Where it gets to be a problem is when we try to look at how complicated operational approaches could affect/improve project yield.
Erlewine	5a	An improved interface between real-time operations and the model is needed.
Chan	4b	A criticism that she has heard is that the model does not quite characterize the operations of the system in the same way that the operators would operate the system.
Not For Attribution	4	CALSIM II's ability to reproduce time series and sequences of operations is a strength.
Not For Attribution	4d	Any single year's results may conflict with what operations staff would produce for that year using their operations forecast. The timing and size of releases and allocations in some areas depart from conventional wisdom of operations given the conditions. CALSIM II does not always simulate the best operations in that one year, but rather provides an approximation of actual operations, which are better informed and more thorough. This is important to keep in mind when interpreting results.
Link	4f	There are problems representing project operations to reflect real-time operations. This is a very common operator-modeler problem. For this reason, it is hard to calibrate a planning model. This is not a problem that is unique to CALSIM II.
Maher	4a	As with any model of this type, project operators do things that cannot be modeled.
Not For Attribution	4	Short-term decisions are hard to represent and there is little experience representing them
Not For Attribution	4	Some aspects of real-time operations are not easily implemented in a planning model. This is especially true of temperature and biological objectives.
Not For Attribution	4	"How does one simulate the neuroses of operating decisions?" This is a difficult problem. Eventually, the model should allow operations to test operating rules.
Grinnell	4c	In various forums questions have been raised regarding the validity of how the model simulates SWP operations.
Not For Attribution	5	CALSIM II should reflect operators' decisions.
Not For Attribution	5	The ability to adjust CALSIM II's synthetic hydrology to reflect the current year's conditions would allow for a more realistic depiction of operations, especially later in the water year. However, it is recognized that such an undertaking would require an enormous effort by staff.
Not For Attribution	4	CALSIM II's allocations of storage in response to hydrologic conditions are particularly different from real operations. CALSIM II holds and releases water counter to what operators would do.
Not For Attribution	4	CALSIM II cannot update predictions of deliveries to users based on changing monthly snowpack conditions, while operators do so in reality. For this reason, CALSIM II is not used for real-time operations.

Erlewine	4b	The forecast probability data used to make contract allocations in CALSIM II for each month is not very accurate. The data is not nearly as good as the data available to real operators. Allocations can be inaccurate (not biased over or under on average, just inaccurate).
Erlewine	4b1	The model takes the runoff and uses the probabilities to determine what volume of water will be available for allocation over the next water year. It does not include the snowpack that actual operators see, so it could miss-estimate the available water in high or low snowpack years.
Munevar	4g	The lack of explicit definition of risk is a weakness of CALSIM II. The level of risk for each CALSIM II simulation is user dependent. A more structured approach to allocation reflecting real-time operations is needed to "tighten" the system simulation.
Munevar	5c	Allocation procedure needs further work. The lack of explicit definition of risk is a weakness of CALSIM II. The level of risk for each CALSIM II simulation is user dependent. A more structured approach to allocation reflecting real-time operations is needed to "tighten" the system simulation.
Bourez	4p	CVP and SWP allocations through the WSI/DI (water supply index/delivery index) curves are difficult to work with and do not reflect the operator's decision making process, DWR and Reclamation are currently working on this issue.
Bourez	4p	CVP and SWP allocations through the WSI/DI (water supply index/delivery index) curves are difficult to work with and do not reflect the operator's decision making process, DWR and Reclamation are currently working on this issue.
Wang	4h	Every time a new facility or demand is analyzed, the water –supply index-demand index curve (delivery logic) needs to be re-calibrated. The re-calibration feature within CALSIM II needs to be triggered manually or the results may be inconsistent.
Not For Attribution	4	There are problems with water allocation algorithms. Long-term deliveries are fine, but they are very bad in spots. When comparing CALSIM II and PROSIM, the delivery frequency curves are very similar.
Not For Attribution	4	The simulation of the allocation process needs work. It is a challenge to mimic what is done in practice, since in reality, allocation is the "final result" of many considerations. The declaration of water supply available to contractors is updated monthly (in both CALSIM II and reality). CALSIM II's final allocations "don't look quite right" given hydrologic conditions.
Not For Attribution	4	The allocation logic in CALSIM II is very crude and empirical. This is currently being addressed in efforts to make CALSIM II better reflect real-time decisions of operators.
Not For Attribution	4	CALSIM II operates and allocates water based on water year (October 1 through September 30); however, SWP allocates water based on calendar year, while the CVP allocates water from March 1 through February 28. The difference in water allocation period makes it difficult to compare between CALSIM II and the short-term operation plans.
Erlewine	5c	Improved representation of contractor behavior would be useful. However, this might cause additional problems, because contractors will not want to be second-guessed by the modelers.
Not For Attribution	4	The model is fine now for delivery reliability estimation.
Snow	4a	CALSIM II seems to overestimate deliveries compared to real-time operations and operations spreadsheet models some times.
Fryer	4c	Exports simulated by CALSIM II are "a bit on the high side". In KCWA studies, CALSIM II deliveries are discounted by approximately 10 percent. While PROSIM studies showed approximately 65% of full deliveries for long-term studies, CALSIM II shows close to 73% of full deliveries.
Maher	4d	JM wants to believe that operators can get more water out of the projects than CALSIM II predicts. In wet years, SCVWD may round CALSIM II results up for their own planning purposes, since CALSIM II rounds allocations to the nearest 5 percent. In dry years, they round down to reflect conservation during droughts.
Not For Attribution	4	Work has been started to investigate iterating target deliveries with demands using LCPSIM.
R Brown	4p	There is no feedback on demands in the model. CALSIM II assumes fixed annual demands that do no reflect the hydrologic conditions.
Rosekranz	4e	For predictive uses, CASIM II deliveries should be de-rated, based on comparisons with historical performance.
Denton	4h	RD wonders about the need to plan for more realistic and/or extreme droughts, perhaps by using stochastic hydrologies. Some water agencies have developed their own drought planning sequences that are much more severe than recent historical droughts.
Denton	4i	RD expressed concern regarding CALSIM II's ability to realistically reflect dry-year operations. He believes that, in future and past drought years, actual drawdown of reservoirs has been less than that depicted in the model because of Drought Water Banks and fallowing and groundwater pumping by upstream water users. Similarly, CALSIM II needs to more accurately account for use of Delta export pumps for Joint Point and water transfers.

Shum	4h	The Central Valley water supply has shown drought management flexibility that might not be simulated in CALSIM II. In extreme droughts, alternative options to meet demands such as water transfers (with fallowing), conjunctive use, and other practices might occur to an extent not modeled. As a result of this lack of elasticity in demand management, competing needs might not be met in extreme droughts. An example is Shasta carryover storage, which is below the end-of-September objective of 1,900 TAF more often than expected in the benchmark study.
Shum	5h	The Central Valley water supply has shown drought management flexibility that might not be simulated in CALSIM II. In extreme droughts, alternative options to meet demands such as water transfers (with fallowing), conjunctive use, and other practices might occur to an extent not modeled. As a result of this lack of elasticity in demand management, competing needs might not be met in extreme droughts. An example is Shasta carryover storage, which is below the end-of-September objective of 1,900 TAF more often than expected in the benchmark study.
Not For Attribution	4	CALSIM II does not handle the critical dry period well (e.g., 1977). SWPOCO is currently working with the Planning division to understand why CALSIM II over-estimates the drawdown of upstream reservoirs during this dry period.
Not For Attribution	4	There are problems with CALSIM II's representation of targets for carryover storage. CALSIM II draws Oroville down much further in the first dry year after a wet year than operators do in reality and operators are more aggressive about moving water from north of the Delta to the South in wetter year types than CALSIM II depicts.
Not For Attribution	4	Current representation of (b)(2) is good
Not For Attribution	4	Current regulatory constraints cannot be implemented in a planning model. The biological assumptions incorporated in a planning model do not capture the adaptive nature of the process. It is not just the time step, but also the actual nature of the process. The biological assumptions that are modeled may or may not occur every year, but are modeled as if they do. It does not make sense that CALSIM II results should be used to make ESA jeopardy calls.
Not For Attribution	4	CALSIM II is flexible enough to represent many things. But the problem is one of trying to simulate a moving target, such as with environmental requirements and the degree of aggressiveness in carryover operations.
Not For Attribution	4	EWA representation is poor, but it is very hard, if not impossible to model the EWA. Rather than run the EWA layer of CALSIM II, prefers to perform the EWA analysis manually.
Upadhyay	4d	There are concerns with the way CALSIM II deals with the EWA. Perhaps DWR needs to "take a stab at" where the EWA will be in the future.
Not For Attribution	4	CALSIM II is the most comprehensive analytical tool available describing the CVP and SWP system, including the layered regulatory requirements (D-1485, D-1641, B2, and EWA).
Fullerton	4e	EWA is poorly portrayed in CALSIM II. Additional effort is needed to correlate environmental performance to hydrology. Currently, EWA runs are fairly speculative regarding the actions that would be taken. EWA is modeled as described in the ROD, and not as it is operated in "real life".
Snow	9a	It has done an "admirable" job trying to look at adaptive management approaches (ex. (b)(2) & EWA), but it still needs improvement. However adaptive management is difficult to model and he recognizes that fact.
Not For Attribution	4	Operations rules are good except for EWA. Would like to have an assessment of functionality of EWA (actual performance) as well as representation of EWA in CALSIM II
Fryer	4h	The operating rules are likely to be outdated by the time they get implemented in the model. This appears to be the case with EWA and take limits.
Not For Attribution	4	Demand patterns and representation of the EWA need refinement.
Not For Attribution	5	Improved representation of the EWA and (b)(2).
Not For Attribution	4	Similarly with EWA. There is very little information/ experience to model EWA. Current modeling of EWA is mostly based on assumptions.
Not For Attribution	4	"A model is never done." Given that, CALSIM II needs better representation of some systems operations, such as EWA, and (b)(2), which recently have been better clarified in courts.
Not For Attribution	5	Ongoing developments of CALSIM II to better represent system operations for EWA, (b)(2), and water quality are warranted.
Tull	4j	Representation of the Environmental Water Account needs improvement. The EWA is difficult to model, but the current representation makes it difficult to compare studies.
Not For Attribution	4	It would not have been possible to model (b)(2) accounting or EWA water using the older models. CALSIM II has already surpassed their capabilities.
Not For Attribution	5	On going developments of CALSIM II to better represent system operation for EWA and (b)(2) operations are warranted.

Not For Attribution	4	The assumptions that go into the final EWA layer of CALSIM II are crude in comparison to the fluidity of actual EWA actions, and so final results of CALSIM II do not reflect actual operations.
Not For Attribution	4	CALSIM II is beginning to address the emerging water transfer market in California it at the EWA level. However, much work is still needed in this area.
Not For Attribution	4	CALSIM II uses "magic water". Unless the mass balance is fixed CALSIM II cannot be used. The SWRCB now has to deal with the political repercussions of the Vernalis standards that were set too high because of "magic water" in DWRSIM. For the EWA runs, CALSIM II says there is either a willing seller or Yuba River water available. However, this water is not taken from anywhere to preserve mass-balance. This results in EWA runs showing benefits relative to less stringent constraints.
Not For Attribution	5	Because of the nature of operating to B2 and EWA, periodic review of how B2 and EWA are implemented will be needed.
Not For Attribution	5	An EWA workshop should be set up to refine that aspect of CALSIM II.
Munevar	4f	The (b)(2) and EWA simulations are an improvement but still have some way to go.
Fullerton	4g	The representation of Article 21 (Monterey Agreement) water is very crude. Locally developed storage and treatment options have resulted in demand for Article 21 water to be greater than previously estimated. This is a very important effect that is not captured in CALSIM II.
Not For Attribution	4	CALSIM II is not good at predicting carryover deliveries and conveyance operations. CALSIM II's ability to realistically depict Article 21 water, Carryover deliveries, and conveyance operations can be improved by refining the assumptions and input used for the model.
Not For Attribution	4	There are many specific operations that SWP undertakes during the year (i.e., carryover contract rights, Article 21 water) that CALSIM II cannot capture. These will be difficult to represent.
Bourez	4e	Need to better model Refuge demands. Agricultural efficiencies are used and ponding operations are not included.
Bourez	4d	Rice decomposition demands are not represented in CALSIM II. Rice operations need to be revised.
Erlewine	4a1	Carryover contracts are not included. CALSIM II does not allow contractors to carryover contract storage from year-to-year.
Not For Attribution	4	The representation of the Feather River operations is outdated.
Not For Attribution	4	Many improvements were made to the representation of the SWP system, but not to the representation of the CVP.
Not For Attribution	4	D-1644 on the Yuba River has been implemented in CALSIM II. That is strength when compared with previous models.
Not For Attribution	4	Many of the problems have been around for a while. For instance, San Luis operations require post-processing. This has been a problem for over 20 years and was carried over from previous models to CALSIM II. CALSIM II operations need to be more appropriate.
Denton	4a	CALSIM II represents the CCWD CVP diversions from the Delta in the same way that they were modeled in DWRSIM, that is, as a time-series of CVP diversions provided by CCWD (shortages are not dynamically applied, they must be pre-preprocessed as input). CALSIM II should be modified so that CCWD diversions are dynamically calculated in the model taking into account both CCWD's CVP allocation. This error will become more pronounced as CCWD's use of CVP water increases if it is not addressed.
Sun	4k	Many of the simplifications inherited from PROSIM and DWRSIM for local operations are still in CALSIM II.
Not For Attribution	4	Water quality objectives in the Delta can be met by a variety of release/export schedules over time. There are significant differences in the water cost and water quality resulting from these patterns, and the scheduling strategies used by operators have both a short-term (spring-neap, wind) component and a long-term memory component. Depending on the focus of the CALSIM study, release and pumping schedules should be either 1) typical or 2) optimized. Instead, flow patterns are neither optimized over time nor do they necessarily account for typical operator behavior and expertise. This may underestimate operator's abilities to meet water quality objectives.
Not For Attribution	5	Operating rules for other water quality constituents.
Not For Attribution	4	It is difficult to derive operating rules for the In-Delta storage facility, as there is not enough data.

Model Complexity

Summary Lead	Comment Number	Comment

Not For Attribution	9	CALSIM is very complex (as compared to PROSIM and other early models) due to the comprehensive treatment of the State Water Project and the Central Valley Project, and due to more advanced technology. Ten years ago one developer could just about keep up with PROSIM development. Now many are contributing simultaneously. Version control must be addressed much more rigorously. Quality control is more difficult because it is not possible for an individual to understand all aspects in detail. The political environment that CALSIM must be applied to is much more complex. This technical and political complexity act in concert to require a complex management.
Not For Attribution	5	The model has been asked to examine projects that have very complex operations (e.g. Sites Reservoir) affecting Sacramento River flows, diversions, EWA, changes in Delta water quality, and exports. CALSIM II is up against much bigger challenges than its predecessors.
Not For Attribution	4	The California water system is very extensive and complex. The complexity of CALSIM II only reflects the complexity of the system.
Boardman	4b	CALSIM II is a powerful model designed to simulate a very complex system. However, this should not come at the cost of ease-of-use. The WRESL language is very cryptic. CALSIM II is difficult to modify even for very simple analysis. Changing WRESL code in one part of the model could cause conflicts in other parts of the model if the user is not adept with CALSIM.
Bourez	4h	One needs a lot of experience with CALSIM II and knowledge of the system to be able to use CALSIM II.
Bourez	9a	CALSIM II development is headed in the right direction, but some hurdles remain. It is important to get people to understand that it is necessary to understand the system to be able to model it with CALSIM II or any other model.
Purkey	4c	The current setup of CALSIM II is very intimidating in terms of understanding how CVP and SWP operations are represented within the model.
Fullerton	4j	DF finds it hard to obtain desired CALSIM II runs. He finds the model hard to set up, check, and get results.
Not For Attribution	4	CALSIM II is very far from the original vision and expectation that it would be accessible to everyone.
Tull	4p	CALSIM II was described as a model that can be "run on your kitchen table." In practice, however, CALSIM II is a difficult model to learn. It takes at least six months of experience to be able to determine if results and assumptions are reasonable. Much of the burden falls on the person doing the analysis. It takes considerably more effort to learn CALSIM II than it did PROSIM or DWRSIM.
Not For Attribution	4	Previous models were good training tools. Junior staff could come up to speed on how the system works by using earlier models. This is no longer the case. CALSIM II is such a complex model, it takes much "human investment" to understand it.
Fullerton	4b	CALSIM II is too complex to be easily upgraded to analyze different scenarios.
Not For Attribution	4	CALSIM II is cumbersome to use.
Not For Attribution	4	CALSIM II is an unwieldy model.
Not For Attribution	4	Many parts of the model are better done in CALSIM II than they were in PROSIM and DWRSIM. However, the whole package is not, as CALSIM II is now so complex as to be unwieldy.
Not For Attribution	4	CALSIM I was more manageable; CALSIM II is harder to work with and a lot more involved in terms of understanding how it works and what is going on. The CALSIM II interface is more complex, especially with different "layers." CALSIM II takes weeks or months to learn.
Rosekranz	4a	CALSIM II's learning curve is too steep. Cannot run the model despite having taken the training class. Used to run DWRSIM, but CALSIM II is too hard to modify and run. Does not know where to begin to modify capacities, rule curves, etc. CALSIM II was designed to be easier to use. However, it is now much more complex and harder to use than its predecessors.
Tull	8h	CALSIM II is not a calibrated, validated model. The quality of results is dependent on how the model is run. Experience is required to both run and understand CALSIM II. The learning curve associated with CALSIM II is a function of the complexity of the Central Valley system as much as of the complexity of the model.
Not For Attribution	4	CALSIM II is becoming rather complicated, with only a small pool of people that understand the model enough to make changes. We are going back to the same problem that we had with PROSIM and DWRSIM, where only very few people were proficient enough to work with the model.
Not For Attribution	9	"As with any model, we need to be cautious of not putting too many features into CALSIM II." CALSIM II is quickly becoming too complex for most users and applications. If all the features are necessary, then two versions of the model should be maintained; a high end and a low end product. The low end product would allow for quick, gross analyses, while the high end would allow for more sophisticated detailed analyses.
Not For Attribution	4	CALSIM II is harder to use than previous models. Perhaps that is a problem that will be overcome with time.

Not For Attribution	9	In general, models need to be as simple as possible so that the average user can understand and use the model with confidence. The most important thing for a model is that the user needs to have confidence in the model and its results. In other words, the model needs to be "user-friendly."
Fullerton	5j	The model should be made modular, so that extra features being added could be turned on and off depending on the needs of the model user.
Fullerton	5k	DF would like to see a model that is easier to run or to have more people who are able to run it.
Not For Attribution	4	Has some reservations about CALSIM II's size and resource requirements (both computer and especially human). "It's a monster" and he wishes he knew the model better.
Rosekranz	5b	Would like CALSIM II to be easier to use so that runs can be done locally.
Boardman	5a	CALSIM II should be developed so that stakeholders can run it without using consultants. Ease-of-use should be a priority.
Not For Attribution	4	It is sometime very difficult to determine if the model is acting appropriately, and if not, why not. CALSIM II is a mix of constraints and priorities. There is a lack of post-processors to aid in interpreting results and correcting errors
Not For Attribution	4e	CALSIM II is a complex model that simulates a complex system. The learning curve for anyone using CALSIM II is steep, as it requires a significant amount of time and patience to interpret its results. It may take hours or days to find the root of flawed operation if one does not possess a good understanding of LP.
Not For Attribution	4	It is difficult to understand and interpret CALSIM II results. There is no tool to easily visualize simulation results and obtain answers to common questions.
Kirby	4d	There are no specific criteria to define a "good" model run. Currently only a small group of individuals "expert users" can decide if a model run is "good." This group is sometimes perceived to not be open to outside interaction and can raise the notion that they [DWR and USBR] are hiding something.
Not For Attribution	4	CALSIM II does a good job of detailing operating policies and environmental regulations. This strength is also a weakness, as it is almost impossible for a layperson to understand model results.
Maher	4f	When they see CALSIM II results that are "way off", it is impossible to know if the error is in the model or in the way it was run (this was true for DWRSIM output in the past as well). As a result, SCVWD plans to develop in-house ability to run CALSIM II in the future.
Purkey	4f	There is no defined metric against which to compare CALSIM II results. Even given the benchmark study, there is no standard for which specific parameters should be considered when comparing the results of two studies.
Not For Attribution	4	CALSIM II results can be difficult to interpret and does not necessarily represent reality well.
Not For Attribution	4	Interpretation of results is more important than the results themselves. Now that many groups are using CALSIM II, there is concern that these interpretations may vary and conflict, especially when groups use CALSIM II in a stand-alone (rather than comparative) mode. The SWPOCO is comfortable using CALSIM II for long-term operations because it has staff capable of interpreting the model's output appropriately. When used without appropriate interpretation, the results could provide more "data" than "information."
Not For Attribution	9	Previous models were used extensively, including in the support of court decision. We were used to them and knew their strengths, weaknesses, and limitations. That understanding will take a while to develop with CALSIM II. In the meantime we need to spend much time explaining CALSIM II results to clients
Wilkinson	4h	CALSIM II is transparent but not accessible or user-friendly.
Spivy-Weber	9b	The Legislature might be more supportive of funding for modeling if the subject were made less intimidating.

Time Step

Summary Lead	Comment Number	Comment
Herbold	4c	A shorter time step is needed. George Barnes promised a shorter time step prior to the development of CALSIM II. Many environmental standards are on a scale of days and monthly average conditions are inadequate Also, there is a tendency for the longer time step to overestimate deliveries-- i.e. in a historical month, like February 1983, when the first half was dry and the last half was very wet then the average monthly flows would allow a higher level of export than would actually be possible under a daily operation.
Not For Attribution	4	The time step should be reduced.
Not For Attribution	4	A shorter time step would be better for many purposes. A daily time step would better capture hydrologic variance and better represent the estuary, reservoir operations, and river temperature.
Not For Attribution	4	For several types of analyses, a smaller time step would be necessary to capture the full effect of hydrologic variability (e.g., Sites Reservoir).

Erlewine	4i	The time step is too large. For example, CALSIM II cannot represent surplus flows accurately, which effect pumping, export and storage capacity in the system.
Boardman	4a	The monthly time step is too large. The time step should be at a minimum weekly, and perhaps daily. A shorter time step would better capture the hydrologic variability that occurs during the year (e.g., spring months).
Rosekranz	4f	Because of the monthly time step, CALSIM II is over-optimistic for export capabilities. Large Delta inflows that occur for part of the month are averaged out for the entire month. This results in an apparent ability to run export pumps at the limit for the entire month, which is not realistic.
Not For Attribution	5	A daily time step version of CALSIM II needs to be developed for special applications like analysis of the Delta Wetlands project.
Not For Attribution	5	A daily simulation capability would be appropriate for analysis of stream flows and Delta standards that have a shorter time step than monthly.
Not For Attribution	5	A smaller time step is important for many projects.
Wilkinson	5c	There should be an open process to determine the appropriate or ideal time step for CALSIM II. Would a daily time step be short enough? If not, how small a time step is necessary, and what would it take to implement such a time step?
Vorster	4a	He doubts that CALSIM II can be used to simulate Article 21 and re-scheduled water. A smaller time step would be required for these studies.
Not For Attribution	4	The monthly time step may be too large for a number of projects. A daily time step would be more useful in a number of studies, particularly those requiring interaction with DSM2.
Not For Attribution	4	Monthly representation of Delta operations is another weakness of CALSIM II.
Miller	4a	CALSIM II uses a monthly time step. An example of the difficulty in dealing with the monthly time step is a "gaming exercise for the Environmental Water Account" where CALSIM II monthly output had to be disaggregated into daily data for both Delta and water transfer options. The daily time step is important both for representation of Delta regulations as well as representing details of water transfer operations.
Not For Attribution	4	A daily simulation capability is needed for analysis of Delta facilities (e.g., Delta Wetlands Project).
Not For Attribution	4	A daily time step is needed for Delta operations.
Not For Attribution	4	One of the weaknesses of CALSIM II is the monthly time step. A monthly time step cannot accurately model some daily or weekly time step regulatory standards .
Not For Attribution	4	CALSIM II cannot be used to analyze impacts resulting from fishery and operational constraints due to its long time step.
Fryer	4b	Time step is too large.
Not For Attribution	4	A daily time step would be an improvement.
Not For Attribution	4	A shorter time step is needed for many applications both because of institutional constraints and to better simulate the system..
Not For Attribution	4	Planning models that are run on a monthly time step cannot consistently represent project operations because the standards to which projects are operated occur on a shorter time step.
R Brown	4k	CALSIM II operates on a monthly time step, but many features (ex. reservoir and Delta operations) occur only a shorter time step (ex. daily or weekly). System features such as EWA, VAMP, flood control, fisheries, and Delta requirements cannot be adequately analyzed with a monthly model. Presently there are "duct-tape efforts to try and work around the monthly time step," but linking daily sections within monthly models is not a "good foundation" for modeling efforts.
Fullerton	4f	The monthly time step in CALSIM II results in biased results, in some cases by as much as 100 to 200 thousand acre-feet per year additional pumping. It is much easier to meet standards in a monthly model. A shorter time step is needed. The EWA gaming exercises showed that the monthly time step is a problem, particularly with regard to Delta operations. A weekly time step, although not ideal, would be a great improvement.
O'Connor	4d	CALSIM II uses a monthly time step. Without testing it is difficult to tell if a daily model would be more accurate and useful because a daily model would require even more data and assumptions to characterize the system. For planning activities, a daily model seems unnecessary.
Denton	4f	Timesteps of less than one month (1-2 weeks) apply better to actual conditions and more realistically represent actual operation changes.
Upadhyay	4g	A smaller time step is needed to represent the operations of the State Water Project. If CALSIM II could be run on a shorter time step (i.e., weekly or less) it would make comparisons with other planning and operations models easier.
Wilkinson	4e	CALSIM II needs a shorter time step. A monthly time step may be sufficient for comparative studies, but a daily or possibly and hourly time step is necessary for management decisions such as pumping. CALSIM II needs to be able to capture high flow events using a short time step.

Herbold	5b	A shorter time step.
Hilts	5a	Not a CALSIM II activity, but a CALSIM (the semi-generic model) activity, yes. A weekly or bi-weekly model for a one-year time horizon would be very helpful for seasonal operations planning and evaluation including (b)(2) and EWA.
Not For Attribution	5	Not convinced that weekly time step benefits are worthwhile in terms of the effort required to develop the model and assumptions required to develop the input data.
Fryer	9a	He would like to see a CALSIM II with a smaller time step. A daily time step would be ideal to analyze Article 21 water availability and the daily operation of local facilities.
Not For Attribution	5	Smaller time step.
Not For Attribution	5	A daily time step. This is in progress in specific regions and basins.
Not For Attribution	5	Further development of the daily model
Vorster	5d	A smaller time step, possibly daily, would be required to simulate Article 21 and rescheduled water.
Sun	5b	Shorter time step. A daily time step would be particularly useful for TMDL water quality computations.
Not For Attribution	5	Daily time step.
Not For Attribution	5	Refinement of spatial and temporal discretization.
Not For Attribution	4	Some sub-components of CALSIM simulations reflect systems where hourly or daily dynamics have an important bearing on decisions. When these are applied in a monthly CALSIM model, the effects of these decisions must be aggregated to monthly time steps. Take, for instance, the question "what is the highest monthly pumping value allowed while fulfilling a stage constraint in the south delta". Such a constraint will be active only for a few moments each month. In the field, operators will briefly cut pumping or flatten their electricity-based schedule until the monthly low tide is passed and then resume pumping normally a day later. This short-term adjustment barely makes a dent in terms of monthly average, and a good method of aggregations would reflect this. In contrast, CALSIM and its supporting DSM2 runs assume a "flat-line" whereby the flow during the entire month must be the same as the critical stage moment. Under such a restriction, a few hours' worth of problems may cause an entire month of pumping reduced by 50%. This does not mean that the monthly time step is inadequate for CALSIM, but rather that small-time-scale decisions must be aggregated more thoughtfully into monthly costs. In fact, daily hydrology may exacerbate this problem, since it is usually drawn and scaled from historical records and thus will not usually have a crisis in exactly the same part of the month as the scenario at hand.

Model Flexibility

Summary Lead	Comment Number	Comment
Boardman	4f	Operating rules and north-of-delta demands are not easily modified.
Not For Attribution	4	Flexible, highly modifiable. CALSIM is well equipped to tackle almost any Water Resources planning scenarios that deal with larger scale, long-term planning horizons. May be the only tool available that can model California's complex water issues dynamically on a statewide scale.
Not For Attribution	4	CALSIM II is the best model so far in terms of its capabilities. However, we do not necessarily get a better product from it, as much effort is still needed on basic input data.
Purkey	4b	CALSIM II is a general model, but it is easy to customize and move components, including new additions, around the geographic system.
Not For Attribution	4	CALSIM II is a tool that can be built upon and serve as a framework for future work.
Not For Attribution	9	CALSIM II is an excellent tool for performing statewide studies and for comparing alternatives. Any model can be enhanced and CALSIM is no exception; it depends on the nature of the application and use of the results. As model purposes and applications change, the model needs to be continuously enhanced both from the engine perspective and the application. CALSIM II is an efficient and flexible model of the CVP/SWP systems and is available to the public (both generic form and application to the CVP/SWP system). CALSIM II is versatile enough that it can accommodate changes and modifications.
Not For Attribution	4	CALSIM II is flexible enough to represent many things. But the problem is one of trying to simulate a moving target, such as with environmental requirements and the degree of aggressiveness in carryover operations.
Wang	4a	It is relatively easy to adapt and change CALSIM II to reflect new regulations.
R Brown	4c	One of CALSIM II's strengths is its' flexibility. It is object oriented and has an open architecture. It is possible to add or modify operating rules and to add new facilities to the model.

Link	4b	The WRESL code and solver are very powerful. CALSIM II has the flexibility to represent a wide range of operating rules.
Vorster	4d	Users should be able to easily evaluate different water demand scenarios.
Spivy-Weber	5f	Hopes that CALSIM II will be flexible enough to show operational changes to the system as they are made.
Sheer	4b	It is the only model capable of flexibly representing operations.
Munevar	4b	One of the greatest strengths of CALSIM II is its flexibility. It is relatively simple to incorporate new rules, particularly when compared to its predecessors.
Not For Attribution	4	CALSIM II is easier to modify than PROSIM or DWRSIM.
Not For Attribution	4	CALSIM II is more transparent and versatile than PROSIM was.
Not For Attribution	4	CALSIM II is in many ways more flexible than previous models.
Not For Attribution	4	CALSIM II's level of detail provides capabilities to look at changes to the system that no other model can evaluate.
Not For Attribution	4	The strongest aspect of CALISM II is perhaps also one of its weakest features. While CALSIM II can be easily modified to simulate almost anything, there are dangers associated with this flexibility. Because it is easy to make changes to CALSIM II, changes can be made at a very fast rate and thus can be difficult to track. It takes considerable scrutiny and review when changes are made to CALSIM II.
R Brown	4d	One of CALSIM II's weaknesses is its flexibility. Model users can add any feature they want, so that there can potentially be many different versions of the model being used simultaneously. And these versions seem to be "drifting apart." There is no standard (i.e., official) version of the model, even though the hydrology is now standardized.
Williamson	4c	It is relatively easy to modify the system, but this also makes it difficult to keep track of all the changes that have been made to CALSIM II.
Bourez	4r	CALSIM II is very versatile. It lends itself to being able to incorporate almost anything, but calibrating the weights can be very difficult.

Representation of Management Options

Summary Lead	Comment Number	Comment
Shum	4h	The Central Valley water supply has shown drought management flexibility that might not be simulated in CALSIM II. In extreme droughts, alternative options to meet demands such as water transfers (with fallowing), conjunctive use, and other practices might occur to an extent not modeled. As a result of this lack of elasticity in demand management, competing needs might not be met in extreme droughts. An example is Shasta carryover storage, which is below the end-of-September objective of 1,900 TAF more often than expected in the benchmark study.
Spivy-Weber	5e	The more CALSIM II can resonate with reality at the regional level, the better. This fits with the current regional emphasis and the way that water systems operate in reality.
Spivy-Weber	4c	CALSIM II, as I understand it, does not represent local projects that contribute to the supply system. These include groundwater conjunctive use in Southern California, recycled water, dynamic representation of conservation, desalination of brackish water, etc.
Spivy-Weber	5b	Would like the state to be able to model local contributions to supply (i.e., groundwater, recycling, conservation, desalinization, etc.), including interaction of these elements with economic incentives. There is systemic inertia with respect to some of these activities, such as conservation, so that an external stimulus may be necessary for change. MWD is attempting to model individual conservation devices that are part of their incentive programs, which will provide a more nuanced picture of conservation measures.
Miller	4c	CALSIM II represents a very limited variety of water management options, particularly options at local and regional levels. He wonders if CALSIM II can handle the kinds of options that are becoming more common: water transfers and exchanges, water transfer options, and groundwater banking. CALSIM II should "simulate the system rather than the components of the system that used to be most important," i.e., state and federal projects).
Spivy-Weber	5c	Use CALSIM II interactively with regional and other models that add features in which CALSIM II is weak.
Davis	5e	The question is: How do local, regional, and state facilities and options best go together? We need information, data, and systems at all scales.
Grinnell	4d	Biological elements drive Delta operations. There are specific time windows of opportunities for water transfers; the closer CALSIM II simulates Delta operations, the more useful the model would be for his purposes. It is unproven that CALSIM II can reasonably represent Delta operations.
Not For Attribution	4	Presently water transfers must be individually pre-specified (i.e., not economically driven).
Denton	4j	CALSIM II must be able to track project and non-project water so that water transfers can be adequately evaluated.

Fullerton	4d	CALSIM II does not simulate carryover storage and transfers among users.
Chan	4e	She has heard that CALSIM II does not analyze water transfers. CALSIM II needs to be able to capture potential water transfers better.
Not For Attribution	5	The ability to incorporate water transfers into CALSIM II runs.
Vorster	5e	CALSIM II should be able to model water exchanges between MWD and the Friant and Kings River systems and the integration of those exchanges into the SWP system.
Grinnell	4d	Biological elements drive Delta operations. There are specific time windows of opportunities for water transfers; the closer CALSIM II simulates Delta operations, the more useful the model would be for his purposes. It is unproven that CALSIM II can reasonably represent Delta operations.
Fullerton	5i	DF agrees and adds that CALSIM II also should include conjunctive operations of the Colorado River and Delta exports.
Fullerton	4c	CALSIM II is not able to track "water with different names".

Stability/Sensitivity of Model Results

Summary Lead	Comment Number	Comment
Not For Attribution	4	One of the greatest weaknesses for DWRSIM was its sensitivity to slight tweaks in parameters (e.g., carryover storage rule curve). Such sensitivity resulted in difficulty in carrying out realistic comparison of alternatives.
Williamson	4j	CALSIM II now has an LP solver, which creates the potential for multiple solutions. Setting of objective function weights too closely for several contractors within the same priority class might lead to arbitrary selection of the optimal solution (i.e., the solution might 'bounce' between very different corner points for small changes in inputs or re-ordering of constraints). This complicates the problem of showing impact of implementing an action, and may make defense of a model study (e.g. in a court of law) difficult or ambiguous.
Not For Attribution	4	There are multiple optima in CALSIM II. Solutions are not unique. A small perturbation in input can result in considerable changes in results.
Not For Attribution	4	Small changes in the system can cause big changes in output solutions, due to thresholds (e.g. streamflows) that act as triggers for environmental actions.
Not For Attribution	4	It is still not clear exactly which parameters CALSIM II is highly sensitive to.
Shum	4l	In comparing alternatives, month-by-month impact estimates of Delta salinity based on CALSIM II output hydrology may be unreliable. In one particular simulation of two alternatives that are very similar, CALSIM II results show a number of months in which there are large percentage changes (~O(10%)) in Delta outflow that are preceded within a couple of months by changes of comparable magnitudes in the opposite direction. In each one of these periods, the sum total of all changes in upstream releases (Delta inflows) and/or exports over the period is much smaller than the magnitude of changes in individual months. The overall effect of these changes on water supply in each period is small. However, these changes could lead to significant changes in Delta salinity over the same periods if they occur at a time when Delta salinity is already high. Such variations in the differences in Delta outflow between different alternatives could be triggered by assumptions and approximations in the algorithm used in CALSIM II, but may not occur in real time operations. It is difficult to determine whether such impacts are real or an artifact of the model. Presentation of model results as averages over a longer term appear to be more appropriate, as discussed above.
Shum	5l	In comparing alternatives, month-by-month impact estimates of Delta salinity based on CALSIM II output hydrology may be unreliable. In one particular simulation of two alternatives that are very similar, CALSIM II results show a number of months in which there are large percentage changes (~O(10%)) in Delta outflow that are preceded within a couple of months by changes of comparable magnitudes in the opposite direction. In each one of these periods, the sum total of all changes in upstream releases (Delta inflows) and/or exports over the period is much smaller than the magnitude of changes in individual months. The overall effect of these changes on water supply in each period is small. However, these changes could lead to significant changes in Delta salinity over the same periods if they occur at a time when Delta salinity is already high. Such variations in the differences in Delta outflow between different alternatives could be triggered by assumptions and approximations in the algorithm used in CALSIM II, but may not occur in real time operations. It is difficult to determine whether such impacts are real or an artifact of the model. Presentation of model results as averages over a longer term appear to be more appropriate, as discussed above.
Not For Attribution	4	CALSIM II results appear to be insensitive to changes in some inputs, especially annual requested deliveries.
Tull	4o	It is easy to have the results of a CALSIM II run fall within the “noise” of other water being moved around for (b)(2) and EWA, which may obscure the effect of the change to the system that is being modeled.

Snow	4c	The range of CALSIM II results for each year-type is very broad (ex. 50%-90% of allocations in wet years) and often not consistent. The same year-type does not always produce the same flows. This often discourages use of CALSIM II.

Geographic Representation

Summary Lead	Comment Number	Comment
Not For Attribution	4	One of the greatest weaknesses for DWRSIM was its sensitivity to slight tweaks in parameters (e.g., carryover storage rule curve). Such sensitivity resulted in difficulty in carrying out realistic comparison of alternatives.
Williamson	4j	CALSIM II now has an LP solver, which creates the potential for multiple solutions. Setting of objective function weights too closely for several contractors within the same priority class might lead to arbitrary selection of the optimal solution (i.e., the solution might 'bounce' between very different corner points for small changes in inputs or re-ordering of constraints). This complicates the problem of showing impact of implementing an action, and may make defense of a model study (e.g. in a court of law) difficult or ambiguous.
Not For Attribution	4	There are multiple optima in CALSIM II. Solutions are not unique. A small perturbation in input can result in considerable changes in results.
Not For Attribution	4	Small changes in the system can cause big changes in output solutions, due to thresholds (e.g. streamflows) that act as triggers for environmental actions.
Not For Attribution	4	It is still not clear exactly which parameters CALSIM II is highly sensitive to.
Shum	4l	In comparing alternatives, month-by-month impact estimates of Delta salinity based on CALSIM II output hydrology may be unreliable. In one particular simulation of two alternatives that are very similar, CALSIM II results show a number of months in which there are large percentage changes (~O(10%)) in Delta outflow that are preceded within a couple of months by changes of comparable magnitudes in the opposite direction. In each one of these periods, the sum total of all changes in upstream releases (Delta inflows) and/or exports over the period is much smaller than the magnitude of changes in individual months. The overall effect of these changes on water supply in each period is small. However, these changes could lead to significant changes in Delta salinity over the same periods if they occur at a time when Delta salinity is already high. Such variations in the differences in Delta outflow between different alternatives could be triggered by assumptions and approximations in the algorithm used in CALSIM II, but may not occur in real time operations. It is difficult to determine whether such impacts are real or an artifact of the model. Presentation of model results as averages over a longer term appear to be more appropriate, as discussed above.
Shum	5l	In comparing alternatives, month-by-month impact estimates of Delta salinity based on CALSIM II output hydrology may be unreliable. In one particular simulation of two alternatives that are very similar, CALSIM II results show a number of months in which there are large percentage changes (~O(10%)) in Delta outflow that are preceded within a couple of months by changes of comparable magnitudes in the opposite direction. In each one of these periods, the sum total of all changes in upstream releases (Delta inflows) and/or exports over the period is much smaller than the magnitude of changes in individual months. The overall effect of these changes on water supply in each period is small. However, these changes could lead to significant changes in Delta salinity over the same periods if they occur at a time when Delta salinity is already high. Such variations in the differences in Delta outflow between different alternatives could be triggered by assumptions and approximations in the algorithm used in CALSIM II, but may not occur in real time operations. It is difficult to determine whether such impacts are real or an artifact of the model. Presentation of model results as averages over a longer term appear to be more appropriate, as discussed above.
Not For Attribution	4	CALSIM II results appear to be insensitive to changes in some inputs, especially annual requested deliveries.
Tull	4o	It is easy to have the results of a CALSIM II run fall within the “noise” of other water being moved around for (b)(2) and EWA, which may obscure the effect of the change to the system that is being modeled.
Snow	4c	The range of CALSIM II results for each year-type is very broad (ex. 50%-90% of allocations in wet years) and often not consistent. The same year-type does not always produce the same flows. This often discourages use of CALSIM II.
Not For Attribution	4	One of the greatest weaknesses for DWRSIM was its sensitivity to slight tweaks in parameters (e.g., carryover storage rule curve). Such sensitivity resulted in difficulty in carrying out realistic comparison of alternatives.

Williamson	4j	CALSIM II now has an LP solver, which creates the potential for multiple solutions. Setting of objective function weights too closely for several contractors within the same priority class might lead to arbitrary selection of the optimal solution (i.e., the solution might 'bounce' between very different corner points for small changes in inputs or re-ordering of constraints). This complicates the problem of showing impact of implementing an action, and may make defense of a model study (e.g. in a court of law) difficult or ambiguous.
Not For Attribution	4	There are multiple optima in CALSIM II. Solutions are not unique. A small perturbation in input can result in considerable changes in results.
Not For Attribution	4	Small changes in the system can cause big changes in output solutions, due to thresholds (e.g. streamflows) that act as triggers for environmental actions.
Not For Attribution	4	It is still not clear exactly which parameters CALSIM II is highly sensitive to.
Not For Attribution	5	Refinement of spatial and temporal discretization.

Run time

Summary Lead	Comment Number	Comment
Wang	5d	Consider re-coding to allow for parallel processing, to make the model more efficient.
Wang	5e	Improve data transfer efficiency between the each of the 5 modeling layers.
O'Connor	4f	CALSIM II studies take considerable time to prepare and execute. Policy questions arise fairly rapidly, often with many iterations, this requires fairly rapid turn around times. As a result many decisions are made without CALSIM II (or any analytical reasoning).
Hilts	4d	CALSIM II's six hour run time is a major detraction, especially in comparison to the few minutes that it takes to run other models (e.g., PROSIM, DWRSIM, etc.).
Fullerton	4a	CALSIM II is too unwieldy with too long of a turn around time for detailed analysis.
Chan	5b	Decrease the run time. Currently the data transfer is not efficient.
Link	4n	Run time is very long, about three hours on a fast computer. This makes tweaking a model and iterative improvements very difficult and time-consuming. Fall back on using PROSIM when such iterative methods are required. The long run time prevents the use of CALSIM II as a screening tool.
Link	5f	Run time needs to be reduced.
Sun	4a	The run time is too long. Can do at most eight runs of single cycle per day. A full multi-cycle run takes eight hours.
Not For Attribution	4	CALSIM II can be run very quickly.
Not For Attribution	4	Run time is lengthy at 7 hours, in comparison to 15 minutes for CALSIM I. This is due to the additional operational scenarios captured in CALSIM II (e.g., D-1485, D-1641, (b)(2), jointpoint, and EWA), but it makes discovery and correction of input mistakes a long process. It often takes a week to get all the input data correct.
Not For Attribution	4	Compared to DSM2, CALSIM II runs can be performed fairly quickly.
Not For Attribution	4	CALSIM II run time is too long. It is difficult to use CALSIM II for analyses requiring a quick turn-around time. PROSIM and DWRSIM ran in a few minutes, so that it was possible to perform several analyses in a short time. CALSIM II run time is absurd and beyond non-useful. One had better get it right at first, as it takes one whole day to do one run.

Other

Summary Lead	Comment Number	Comment
Not For Attribution	4	CALSIM II model does not appear to be algorithmic. To produce an acceptable CALSIM II run, intermediate model results are viewed and model parameters are adjusted until the desired result is reached. This process involves significant amount of human input, and independent investigators working from the same starting point will not produce the same output. The sensitivity/leeway in results to this type of manipulation should be quantified and compared to the differences between alternatives in the same study. At the same time the formulation should be made more robust so that the solution does not depend on intermediate user input – therefore avoiding the potential criticism that the solution has been "guided" towards a desirable outcome.
Meyer	9a	There are probably several things that could be done differently in CALSIM II, but these are often just individual preferences and not real weaknesses in the model.

INPUTS

General Comments

Summary Lead	Comment Number	Comment
Kirby	4g	It is difficult to make CALSIM II inputs tangible and communicable to stakeholders.
Bourez	4f	CALSIM data development is weaker than the representation of operations.
Bourez	4l	Input data is weak (see above).
Fryer	4d	The quality of the input data seems to be “pretty good”.
Not For Attribution	4b	CALSIM II is the best model so far in terms of its capabilities. However, we do not necessarily get a better product from it, as much effort is still needed on basic input data.
Satkowski	4a	The biggest weakness of previous models was the input data. Model runs were completed for CEQA analyses to establish a base case representing present conditions. However, the results of these runs were inconsistent with reality, providing a weak baseline for comparison. This is still an issue with CALSIM II.
Bourez	4l	Input data is weak (see above).
Not For Attribution	4c	For DWRSIM, many parameters were quantified very subjectively.
Kirby	4h	There appears to be a culture where some inputs are so accepted that they are no longer scrutinized or even understood by some of the current CALSIM II modelers.
O'Connor	4c	CALSIM inhales data. Many detailed assumptions are needed to characterize the system. It seems unrealistic to accurately characterize the system at that high level of detail. This is less of a problem for comparative analysis uses, but it is possible to have mischaracterized the system, which makes it "dicey for policy purposes." Data seems unavailable to calibrate the model at this level of detail.
Wilkinson	4d	CALSIM II requires large quantities of data of many varieties. This significant requirement for the model should be discussed.
Erlewine	4f	The data availability is a limitation.

Demands

Summary Lead	Comment Number	Comment
Sun	4o	Water demands in CALSIM II are based on contracts, rather than true demands.
Not For Attribution	4	Land-use based demands in the San Joaquin valley will result in better simulations than the contract based demands currently in CALSIM II. (Note: The land-use based demands in the SJ valley will be included in the upcoming release of the 2030 hydrology).
Not For Attribution	4	The modeling of demands in CALSIM II needs to be improved. Demands should be based on user behavior rather than contractual amounts.
Not For Attribution	4	Demand patterns and representation of the EWA need refinement.
Not For Attribution	5	Improved demand modeling.
O'Connor	4b	CALSIM II water demands are based on historical December water contractor requests. In December, hydrologic conditions for the year are not known. In reality water users decrease requests if hydrological conditions are favorable; this is not reflected in the model. Consequently the model will predict much greater deliveries than has been historically observed, because demands in the model are often higher than they will actually be
Not For Attribution	4	CALSIM II is now more of a land-use based model, an improvement over previous models that were not as extensively land-use based.
Not For Attribution	5	Land use based demands for south of Delta should be incorporated to CALSIM II.
Not For Attribution	5	Implementation of a land-use model to determine demands based on rainfall cropping patterns.
Not For Attribution	5	Land use based hydrology and demands in the San Joaquin Valley (in progress).
Tull	9e	CALSIM II’s successor should be built from land uses up, depicting real water, basin interactions, and groundwater/surface water interactions.
Not For Attribution	5	CALSIM II should continue to use land use based demands (currently used in the Sacramento river basin, and will be used in the San Joaquin river basin for the 2030 and future hydrologies). A GIS approach will be an ideal tool to delineate agricultural and urban land boundaries and better represent land use especially with finer spatial discretization.
Not For Attribution	4	South of Delta demands needs improvement.
Davis	4d	For the Bulletin 160-98, CALSIM II used southern California demands that were 1 MAF higher than they actually are. Such overestimates of demand skew policy conclusions.
Not For Attribution	4	During the CALFED process, there was shock and disappointment when we realized that despite the considerable investment in water use efficiency, the modeled water demand remained based on contract amount. The way the model was applied was of great concern to CALFED stakeholders. Unsure whether this is a shortcoming of the model or of the way it is being applied.

Tull	4d	On-farm efficiencies are based on calculations from the 1960s, while actual efficiencies have improved considerably since then.
Not For Attribution	5	Water use efficiencies should be incorporated in the development of water demands as input to CALSIM II.
Wilkinson	4g	CALSIM II should use economics and price into its demand-side aspects. Only then will CALSIM II be useful for policy purposes.
Chan	4f	CALSIM II demands are based on climate. For MWD the modeled demands are highest during the dry periods and lowest during wet periods. In practice, MWD demands are highest in the wet periods because they want to fill storage facilities. CALSIM II needs to be able to better model demands based on actual demands.
Not For Attribution	4	Early on, DWRSIM tried to meet the same target deliveries each year. Later, the target deliveries were adjusted for climate variability. CALSIM II now iterates with MWD's IRPSIM so annual delivery targets better represent local demands. The demand variability is less of a concern for agricultural deliveries, since most farmers will use available SWP/CVP deliveries to replace pumped groundwater.
Not For Attribution	4	Land use data from CVPM is used to develop demands for CALSIM II. There should be iteration between CALSIM II and CVPM, but this has not being done in the past. There are also concerns regarding the validity of CVPM and its successor, CALAG, which affect the validity of CALSIM II.
Bourez	4d	Rice decomposition demands are not represented in CALSIM II. Rice operations need to be revised.
Bourez	4d	Rice decomposition demands are not represented in CALSIM II. Rice operations need to be revised.
Bourez	4e	Need to better model Refuge demands. Agricultural efficiencies are used and ponding operations are not included.
Vorster	5o	Develop consensus alternative demand scenarios that can be easily incorporated in model runs.
Kirby	4f	Representations of demands in CALSIM II are not intuitive. They are very complex and not well documented. Demands arise from some complicated and unspecified process. For example, to most people interested in exploring changing conditions, it is not clear how to change demands. Changing contract amounts do not seem to change demands.
Not For Attribution	4	The level of detail in the inputs (e.g., hydrology, demands) for CALSIM II is an improvement over past models.

Hydrology

Summary Lead	Comment Number	Comment
Not For Attribution	5	Enhancements to the input hydrology that are needed include: consumptive use model, better estimates of ET and soil characteristics, greater spatial discretization, and refinement of CVGSM for more localized applications.
Not For Attribution	4	There has been a lack of work on the hydrology underlying the model. Hydrology problems include: demands, efficiencies, reuse, and losses are based on 1970's studies (the data are out of date); no good handle on groundwater pumping; forecasting methodology is different from that used by DWR's Office of Flood Management; poor project/Non-Project splitting of land-use based demands; poor representation of local supplies (e.g., smaller unregulated supplies and the location of their return flows); and CLASIM II lacks representation of indoor non-consumptive use and local water sources for M&I demands.
Wilkinson	4c	Input data are inadequate, particularly for groundwater.
Bourez	4c	DSA basin efficiencies are way out-of-date. "No question that they are too low".
Tull	4a	There has been too much work to develop the "bells and whistles" of CALSIM II and too little on the hydrology.
Not For Attribution	4	The level of detail in the inputs (e.g., hydrology, demands) for CALSIM II is an improvement over past models.
Munevar	4c	The greater detail in the hydrology is a great improvement over previous models.
Bourez	4b	Hydrology in the Sacramento River basin was developed in the early 1960's. Although the methods and level of detail was adequate at the time of development, the model is being used to evaluate more complex questions, which pushes the use of the hydrology beyond the point of accuracy. Much of the hydrology is lumped (spatially) in the Sacramento basin and should be refined to be commensurate with the level of detail in CALSIM II and the analysis being performed.
Erlewine	4g	Not convinced that the Sacramento Valley depletion areas (for hydrology) are modeled well, especially in terms of representing demands and groundwater. Perhaps in the Sacramento Valley, water supply sources should be used rather than drainage areas. Can the depletion areas better match well-known data, gages, irrigation districts, etc.?

Not For Attribution	4	"Everything is weak." The foundation data (hydrology and allocation rules) are weak. Errors in the hydrology are propagated through each layer of the model. The major weakness in CALSIM II is in basic information. The hydrology, although much improved from its predecessors, is still very coarse. Improvements are needed on rim flows, M&I accounting, farm level processes (deep percolation and return flows), etc.
Not For Attribution	4	The hydrology changes that have been made are good.
Not For Attribution	4	CALSIM II surface hydrology is good.
Not For Attribution	5	Investment must be made on improving the hydrology and the allocation rules (see 4a, above)
Not For Attribution	5	Efforts must be made to continue improving the hydrology.
Tull	4b	CALSIM II's hydrology is holding the model back. The basis for the hydrology is dates back to the 1960s and is far behind the rest of the model. However, some improvements have been made in the joint (DWR and USBR) hydrology; CALSIM II's hydrology is a better representation of reality than PROSIM due to a more discrete node network.
Link	4a	One of the greatest strengths of CALSIM II is its single hydrology. But it would be good to know how it was done.
Brown	4a	The strongest feature of CALSIM II is the hydrology data set (the "Joint Hydrology") that had to be created to run the model. The state and federal agencies now have a common, agreed upon set of hydrologic inputs. But these inputs should be updated for recent years (i.e., 1995-present).
Fullerton	5b	PH believes that a GIS method should be developed so that changes to hydrology due to land-use can be better and more easily incorporated. Such a methodology would also help the analyses of water transfers.
Not For Attribution	5	Land use based hydrology and demands in the San Joaquin Valley (in progress).
Tull	5a	Hydrology should be created from land use up. In the current hydrology, it is impossible to see many of the building blocks and to see how the puzzle comes together. It is complex to understand how water balances are maintained.
Tull	5b	Land use based hydrology should be added to the west side of the San Joaquin Valley.
Tull	4g	The land use based hydrology in the San Joaquin Basin is an improvement.
Kirby	4e	The hydrology in CALSIM II is inconsistent across regions. Some hydrology is land-use based, while some is not.
Tull	4h	Hydrology building blocks must be transparent to model users. All hydrology should be thoroughly documented.
Not For Attribution	4	CALSIM II's use of historic hydrologic sequences is a strength.
Not For Attribution	4	CALSIM II uses adjusted historical flows, which is easier for the public to understand.
Not For Attribution	4	The development of alternative hydrology input data sets appears to be a clumsy process, including finding errors in the hydrology that resulted in considerable changes in model output.
Not For Attribution	5	Hydrology data development is difficult and time-consuming, with a prohibitive turn-around time.
Not For Attribution	5	It may be worthwhile to investigate the use of an alternative hydrology other than a specific (fixed) level of current or future development
O'Connor	4j	Global climate change is an important issue and needs to be studied. However, when asked, DWR asserts that they have "no idea how to create the hydrology" and cannot use synthetic hydrology to model the future. The Scripps people pointed out that given climate change "the past is not an accurate predictor of the future", but CALSIM II implicitly assumes that the past is a good predictor of the future.
Not For Attribution	5	A new hydrology set would be required to look a global warming.
Not For Attribution	5	Climate change studies.
Vorster	5m	He would like to unimpaired flow data reflecting pre-development conditions rather than a particular level of development.
Not For Attribution	4	Data gaps for hydrology need to be addressed. Streamflow data and groundwater data are needed for calibration of groundwater models.
Denton	4c	DB would like to see further refinement of the accretions analysis in CALSIM II. Some of CCWD's raw water customers and CCWD's use of its own Mallard Slough water rights result in direct diversions of water from the Delta in wet years, when the water quality is good. This affects CCWD's demand from other sources (such as the CVP and Los Vaqueros water sources) and Delta depletions should be adjusted accordingly. CALSIM II does not presently reflect this (although this adjustment may be small relative to the overall Delta depletions).

Hilts	5b	It would be good to determine if the gross accretions for the Sacramento Valley are "in the right ballpark." DWR is currently working on this. It is as close to validation as one can get with this kind of model.
Tull	4e	CALSIM II's current depletion analysis is very gross.
Tull	4f	A finer geographic representation of hydrology is required.
Not For Attribution	4	Input data is at DSA level, which may be too coarse for some analyses. A lot of the data and parameters sets in estimating land-use based demands could be updated; e.g., rainfall data, crop evapotranspiration, number of crop categories, soil moisture characteristics, water demand efficiencies, etc.
Not For Attribution	4	Some of the input data needs improvement. There is a fair amount of geographic lumping of data in CALISM II. A finer geographic resolution is needed, but it is important that consistent data is used.
Not For Attribution	4	Local hydrologic assumptions for CVPM and CALSIM II do not always agree. This problem is being addressed presently.
Not For Attribution	4	The hydrologic data is weak in certain areas. There is not enough information on groundwater parameters, basin efficiencies (which affect the calculation of return flows), etc. This however is common to any model or tool that uses average basin-wide parameters such as efficiencies and hydraulic conductivities. Some data is outdated and does not reflect current practices such as the flooding of rice fields.
Not For Attribution	4	The Yuba River hydrology is a problem. There are also other data problems that are being worked on, but it will take time to get all these problems fixed.
Not For Attribution	4	The rainfall-runoff simulations for small catchments are poor. They are based on empirical relations that are somewhat weak. Good information on a smaller geographical and time-scales is not available.
Not For Attribution	4	The 80-year hydrology provides a wide range of hydrologic impulses.
Not For Attribution	4	CALSIM II output is the limiting factor in users reliability studies because it only includes 1922-1995. CALSIM II should always include hydrology to within the past two years.
Not For Attribution	4	More recent data (particularly through 1998) are necessary to understand how the model represents a prolonged wet period (1995-1999 is the wettest 5 year period in the available historical hydrology).
Not For Attribution	4	CALSIM II output is the limiting factor in users reliability studies because it only includes 1922-1995. CALSIM II should always include hydrology to within the past two years.
Not For Attribution	5	More recent hydrology (including up to the past two years) should be added to CALSIM II.
Fullerton	5f	PH would like to see hydrology forecasts better represented in CALSIM II. The logic in CALSIM should be more in line with what is done in real-time operations, where inflow is based on snow pack survey results.
Not For Attribution	4	CALSIM II hydrology is inconsistent. Forecasted inflows are used in a few, but not all, basins.

SOFTWARE

Solver

Summary Lead	Comment Number	Comment
Not For Attribution	4	The solver is "buggy" for month-to-month analysis.
Not For Attribution	5	A free multiple-integer LP solver
Not For Attribution	5	Use of an efficient public domain solver, and elimination of the FORTRAN compiler would make CALSIM more accessible without the additional financial costs currently needed.
Wang	4i	CALSIM II requires a commercial solver (XA solver), resulting in licensing issues and rising costs to use the model. There have been a lot of delays in the benchmark study because of required XA modifications.
Wang	5b	Some other potential development works include considering replacing the current linear programming engine by public domain freeware; considering re-coding to allow for parallel processing, to make the model more efficient; improving data transfer efficiency between the each of the 5 modeling layers; and modifying data structure and formulation to allow multiple traces simulation.
Wang	5c	Consider replacing the current linear programming engine by public domain freeware.
Denton	5b	DB would like to see the use of a free Linear Programming solver and expressed concern about investing in an expensive commercial LP solver when there is no guarantee that that solver would continue to be used.
Link	4i	The XA LP solver is expensive.
Link	4k	The XA solver license prevents parallel runs without purchasing additional licenses, as dongels are required to run the model.

Not For Attribution	4	XA solver does not provide enough information such as which constraints are binding, etc.
Not For Attribution	5	More informative output from the solver for debugging purposes.
Not For Attribution	4	The software is limited. It is hard to debug CALSIM II, as the solver does not provide details of LP solution.
Not For Attribution	5	Better debugging capabilities.
Not For Attribution	4	Software weaknesses include: it is hard to debug, especially for infeasibilities and it can take many days to find the source of a problem; and WRESL code documentation is "hit or miss". Portions of it are well documented while others are not.
Not For Attribution	5	Better debugging capabilities are needed.
Bourez	4i	It is hard to track infeasibilities with CALSIM II.
Link	4j	It is harder to figure out what is happening in CALSIM II than in PROSIM or DWRSIM. It is difficult to debug CALSIM II. Error messages from CALSIM II and the XA solver are not useful.
Link	5e	A more sophisticated debugger is needed.
Purkey	4l	LP solver error messages provide inadequate guidance regarding where infeasibilities occur or other sources of the error. One has to reconstruct the model piece-by-piece to debug it.
Sun	4b	It is not an easy environment to debug. DSS output file must be opened to check the calculation.
Sun	4n	The debugger is very convoluted. Mass balance calculations need to be done manually.
Not For Attribution	4	The LP engine is a more efficient code than DWRSIM's procedural code.
Not For Attribution	4	The use of an LP solver is not a good idea for monthly simulations, as there are multiple optimal solutions. It is easy to get different solution for the same inputs. Model runs cannot be replicated.
Link	4e	CALSIM II uses an LP solver, but it is structured with a FORTRAN mentality. The full LP capabilities are not being utilized.
Meyer	4b	CALSIM II is LP based which means the model works in the same manner as an operator in terms of goals and constraints on operations.
Not For Attribution	4	The modularity that comes from using a solver is a good improvement from PROSIM.
Not For Attribution	4	There is no capability to re-run a single time step of the LP.
Not For Attribution	5	Sensitivity analysis with respect to hydrology and demands would be useful.
Not For Attribution	5	A sensitivity analysis of the assumptions used in the hydrology process is needed.
Tull	4n	The CALSIM II engine does not tell the user what parameter is constrained in a run. Because of the model's formulation, users have to "dig" for this information. CALSIM II requires a second step to extract information for a sensitivity analysis.
Not For Attribution	4	The solver can produce non-unique solutions. Theoretically inconsequential changes in the formulation can change the solution by bouncing between equally penalized corner points.
Bourez	4k	The LP solver is unstable, costly, and requires a dongel to run.
Bourez	5k	The LP solver is unstable, costly, and requires a dongel to run.
Sun	4m	The XA solver is unstable. As open-source software, one should be able to take someone else's model and obtain the same results. The exact same model can be run in one machine but not another. Have not been able to come up with an explanation for this behavior. This instability reduces potential collaboration.
Not For Attribution	4	CALSIM II engine is not bad.
Not For Attribution	4	One of the strengths of CALSIM II is its state-of-the-art engine.
Link	4l	XA prevents using a computer for other things while model is running; so dedicated computers for solving the model tend to be used.
Tull	9d	The successor to CALSIM II will need a cleaner formulation (LP or other) that allows for more computational efficiency and better representation of the system.

GUI

Summary Lead	Comment Number	Comment
Not For Attribution	4	There are several errors in the GUI. Tables and charts do not always display output data. GUI has limited graphical capabilities.
Not For	5	Geographical user interface would be useful both for input and output presentation.

Attribution		
Not For Attribution	5	CALSIM II needs a good user interface for both input and post-processing. CALSIM II should be linked to GIS.
O'Connor	4g	Can the model and model results be presented in a way which is more intuitively understandable? Perhaps tied to a GIS?
Fullerton	5b	PH believes that a GIS method should be developed so that changes to hydrology due to land-use can be better and more easily incorporated. Such a methodology would also help the analyses of water transfers.
Kirby	5b	Continue efforts to illustrate linkages between geographic/physical and institutional boundaries in a visual form. Use a GIS coverage map to show how the model translates the district boundaries into aggregated demand areas. It might help to give stakeholders more confidence in their area's coverage in CALSIM II.
Not For Attribution	5	Improved graphic and output processing tools.
Wang	4j	The user interface is "pretty handy" for basic operations, but for more complex operations it needs to be improved.
Meyer	4h	The GUI for CALSIM II is poorly designed. Opening a “study” does not automatically load all the inputs. Instead the GUI requires that the user find, open and load each data table before the data can be viewed. In addition, almost all of the studies run with CALSIM II will be multiple study runs that cannot be handled by the GUI. Instead a Multiple Study Rapper (MSR) is used to execute the model and the only way to look at each study of the run is to open studies separately.
Sun	5h	The user interface is very clumsy. Existing GUI does not allow for data extraction in columnar format.
Rosenkranz	4d	It would be useful if CALSIM II computed water balances at different nodes in the schematic both for debugging and display of results. This was a nice feature of PROSIM.
Not For Attribution	4	There are no visual tools for the schematic.
Not For Attribution	5	Tom Heinzer and Mike Tansey (USBR) have done some work on a network driver for CALSIM II, in which model user would be able to click on any node to obtain all information about that node. This work should be finalized and implemented in CALSIM II.
Munevar	5d	A GUI relating the schematic to the system connectivity would be very useful. The text based connectivity table should be eliminated.
Purkey	5b	A graphical interface showing all nodes in the most current version of CALSIM II would be useful, since most physical schematics are out-of-date with changes to the model.
R Brown	5a	Create a user interface that would allow the user to click on a node and see a list of the features associated with the node. Each node in CALSIM II can represent a number of features, not all of which are transparent to the user (ex. SWP Pumping Facility represents not only the SWP pumping, but also CVP wheeling, EWA pumping, water transfers, Article 21 water).
Rosenkranz	5a	Better model documentation, including hyperlinks. Would like to be able to click on a node to obtain all the information about the node that is used in the model, including where data comes from and where to find the original calculations used to derive it.
Meyer	5a	The GUI needs to be redesigned to accommodate the multiple study runs.
Kirby	5d1	The CALSIM interface class is of limited use. It is a necessary, but not sufficient condition to being able to use CALSIM II.

Output/Post-Processor

Summary Lead	Comment Number	Comment
Shum	5k	An alternative to presenting CALSIM II results “in an absolute sense” (i.e. as one single value) in the short term would be post-processing the monthly results into appropriate aggregates (e.g. as longer-term averages or as total system storage rather than individual reservoirs).
Rosenkranz	4i	Output can only be obtained for one run at a time. It would be useful to be able to obtain the difference between two runs for the various parameters, rather than having to get each separately and import to a spreadsheet to calculate the difference.
Not For Attribution	4	It is sometime very difficult to determine if the model is acting appropriately, and if not, why not. CALSIM II is a mix of constraints and priorities. There is a lack of post-processors to aid in interpreting results and correcting errors
Not For Attribution	4	Many of the problems have been around for a while. For instance, San Luis operations require post-processing. This has been a problem for over 20 years and was carried over from previous models to CALSIM II. CALSIM II operations need to be more appropriate.
Fullerton	4j	DF finds it hard to obtain desired CALSIM II runs. He finds the model hard to set up, check, and get results.
Sun	4c	Production of desired output is not straightforward.
Erlewine	4c	Usability is an issue in CALSIM II. DSS makes it difficult for users to obtain and understand results from a model run. Users should be able to access results in an ASCII

		text file format. Also, there needs to be a way to easily access "standard results" (i.e., those flow, storage, or delivery results that are of interest most commonly).
Not For Attribution	4	It is difficult to understand and interpret CALSIM II results. There is no tool to easily visualize simulation results and obtain answers to common questions.
Not For Attribution	5	A GUI or post-processing tool to make results more easily digestible. Currently everyone is developing their own tools and techniques for post-processing data, which results in use of the same model, but different post-processors.
Snow	5d	CALSIM II output needs a better interface tool.
R Brown	4j	It is not easy to "see" CALSIM II results. The user interface is not much better than the one in DWRSIM.
Rosenkranz	4h	X2 results are presented rounded to the nearest kilometer. I would like to see results rounded to the nearest one-tenth of a kilometer.
Not For Attribution	5	Improved graphic and output processing tools.
Not For Attribution	5	Better presentation of output or a better post-processor would help. Currently, results require significant post-processing.
Not For Attribution	5	A GUI or post-processing tool to make results more easily digestible. Currently everyone is developing their own tools and techniques for post-processing data, which results in use of the same model, but different post-processors.
Not For Attribution	4	There is lack of output data organization in CALSIM II, as well as lack of direction within development staff at DWR.
Maher	4c	SCVWD post-processes CALSIM II results to reflect how they think USBR will operate and how they anticipate SWP will handle M&I vs. agricultural allocations during the year.
Rosenkranz	4d	It would be useful if CALSIM II computed water balances at different nodes in the schematic both for debugging and display of results. This was a nice feature of PROSIM.
Erlewine	5b	Ability to access and use the output data could be improved, as outlined above.

Database/Data Management Software

Summary Lead	Comment Number	Comment
Wang	4b	Data structure is much better than before.
Not For Attribution	5	Development of GIS interaction for land use based demands and for the regulatory requirement layering.
Not For Attribution	5	Model inputs should be restructured so that at least some are in a database (i.e., Access database) rather than text files. This also would allow better tracing of dependencies.
Not For Attribution	5	There is work under way to place all inputs and WRESL code in a relational database, and to include metadata.
Not For Attribution	5	There needs to be some kind of data management for all modeling data, not just CALSIM II, but a branch wide policy on data handling and management. Database should be fully documented and include metadata.
Kirby	5a	An improved input data environment (i.e., create a relational database and software environment for managing and documenting data).
Purkey	4d	The thousands of links between input fields in CALSIM II's data structure make it difficult to understand. BJ is not sure if a database structure for the model would be an improvement.
Not For Attribution	5	Creation of an interface between CALSIM II and other models that will reduce the likelihood of user error. Eventually modify CALSIM II so that it will directly create the input files for other models (such as CVPM or LCPSIM).
Not For Attribution	5	For specific applications requiring use of CALSIM and other models, there has been a common problem of communication between the models. This is because the models were developed as stand-alones and by different groups under different circumstances. This problem needs to be addressed.
Williamson	5b	Certain types of data are always passed between CALSIM II and other models. CALSIM II needs to be able to automatically generate the required output in the correct format for input to other models. This will help to reduce user caused errors.
Williamson	5d	A better data management system and a data interface are needed.
Not For Attribution	4	The current need for different software utilities for each input and links between sections of the model is cumbersome and prone to user error.
Kirby	4c	The data management structure, software, and administration is seriously prone to user error. There is almost no automated quality control in data entry and files.
R Brown	4o	CALSIM II is a comparative model, but there is no easy way to make an incremental analysis. Each model run requires a separate directory with all the input files. The process is time consuming and prone to error.
Wang	9c	Create tool to generalize the QA/QC process.
Not For Attribution	4	There is no centralized location where the calculation files are stored (i.e., no centralized archive for detailed background documentation and calculations).
Not For Attribution	5	CALSIM II would benefit from a better data management system.

Wang	5f	Modify data structure and formulation to allow multiple traces simulation.
Meyer	4h	The GUI for CALSIM II is poorly designed. Opening a “study” does not automatically load all the inputs. Instead the GUI requires that the user find, open and load each data table before the data can be viewed. In addition, almost all of the studies run with CALSIM II will be multiple study runs that cannot be handled by the GUI. Instead a Multiple Study Rapper (MSR) is used to execute the model and the only way to look at each study of the run is to open studies separately.
Williamson	4i	The software environment of CALSIM II is much better than that of DWRSIM, but the data management structure is still very poor.
Link	4h	Models are tricky to modify, with so many input files scattered all over the place. It makes version control difficult.

DSS

Summary Lead	Comment Number	Comment
Not For Attribution	4	Software strengths include: All input data is in common format (either table or DSS). It is relatively easy to understand the data. And CALSIM II WRESL code is very clear. Was able to understand system functionality and learn the system from reading the WRESL code. Learned (b)(2) and Stanislaus River logic from the WRESL code. Does not think that the WRESL code is much more complex than PROSIM code. Believes that model users must take time to read code to use the model.
Not For Attribution	5	Output from CALSIM II cannot be identified from DSS pathnames.
Link	4d	The "pathname" scheme for data stored in DSS files does not identify the simulation the results came from. It is also hard to pull out all DSS data for a specific node/location in the model as more than one specification can be made on a single DSS pathname part.
Link	5b	Inputs and outputs should be better organized so that it makes sense to the model user. CALSIM II should not have two things on one DSS label as this prevents efficient searching of the database. Labels in the schematic should be fixed. Model developers should not expect that model users know that Delta surplus outflow does not mean Delta surplus outflow.
Fullerton	5l	DF would also like to see a better DSS to Excel data transfer utility, including graphics.
Snow	4d	DSS is difficult to use and get results out of in an easy and meaningful manner.
R Brown	4i	CALSIM II results are stored in DSS, which does not have a standard (user-friendly) tool for spreadsheet “interaction.” Also, the results files are “huge.” DWR’s DSS GUI only allows for extraction of one variable at a time, which is inefficient.
Erlewine	4c	Usability is an issue in CALSIM II. DSS makes it difficult for users to obtain and understand results from a model run. Users should be able to access results in an ASCII text file format. Also, there needs to be a way to easily access "standard results" (i.e., those flow, storage, or delivery results that are of interest most commonly).
Not For Attribution	5	DSS may no longer be appropriate because it cannot include metadata
Rosenkranz	4c	Obtaining input and output is easier and more straightforward with the DSS database.
Sun	5i	CALSIM II should move away from DSS and use better databases (other proprietary databases might be too expensive).

WRESL

Summary Lead	Comment Number	Comment
Boardman	4b	CALSIM II is a powerful model designed to simulate a very complex system. However, this should not come at the cost of ease-of-use. The WRESL language is very cryptic. CALSIM II is difficult to modify even for very simple analysis. Changing WRESL code in one part of the model could cause conflicts in other parts of the model if the user is not adept with CALSIM.
Not For Attribution	4	Software weaknesses include: it is hard to debug, especially for infeasibilities and it can take many days to find the source of a problem; and WRESL code documentation is “hit or miss”. Portions of it are well documented while others are not.
Not For Attribution	4	Software strengths include: All input data is in common format (either table or DSS). It is relatively easy to understand the data. And CALSIM II WRESL code is very clear. Was able to understand system functionality and learn the system from reading the WRESL code. Learned (b)(2) and Stanislaus River logic from the WRESL code. Does not think that the WRESL code is much more complex than PROSIM code. Believes that model users must take time to read code to use the model.
Not For Attribution	4	The WRESL code is easy to understand and change. The WRESL code in CALSIM II allows the user the ability to change the model code rather easily. It makes CALSIM II very flexible.
Not For	4	WRESL language is hard to learn, but once learned it is easier than FORTRAN.

Attribution		
Sun	4e	On the flip side, because WRESL is not very powerful, it is very easy to learn, read, and understand.
Meyer	4e	The WRESL language needs to be expanded. In particular, there is too much use of the "define" statement. If the user is not extremely familiar with the "define" statement, the WRESL code can be difficult to understand.
Not For Attribution	4	What was wrong with FORTRAN code? Why should WRESL language be used?
Sun	4d	The WRESL code is not flexible enough; in many situations it is necessary to trick the model or work around its limitations (e.g., extensive use of dummy variables).
Link	4b	The WRESL code and solver are very powerful. CALSIM II has the flexibility to represent a wide range of operating rules.
Not For Attribution	4	WRESL was designed to make CALSIM modeling more transparent, but the model requires hundreds of input files. This has frustrated and inhibited many potential users and given people on the "outside" the impression that CALSIM modeling is a "closed shop".
Sheer	4c	Implementation is difficult with respect to the WRESL language, which makes the user work harder than is needed with OASIS.

Transparency

Summary Lead	Comment Number	Comment
Not For Attribution	4	CALSIM II is easier to change and work with than DWRSIM. If CALSIM II and DWRSIM were lined up to run identical studies, CALISIM II would be easier and faster to set up and run than DWRSIM. Much of DWRSIM data and assumptions had to be put into the code.
Kirby	4a	CALSIM II is "totally data driven." It is "theoretically transparent and indiscernible at the same time." The model's greatest strength is also its greatest weakness.
Meyer	4a	A strength of CALSIM II is that it is data driven so that none of the operating rules or data is within the source code.
Not For Attribution	4	WRESL was designed to make CALSIM modeling more transparent, but the model requires hundreds of input files. This has frustrated and inhibited many potential users and given people on the "outside" the impression that CALSIM modeling is a "closed shop".
Not For Attribution	4	One of the greatest strengths of CALSIM II is its transparency in terms of model accessibility, data, and assumptions.
Not For Attribution	4	One of the contributions of CALSIM II to California water is its open architecture and data structure. It makes both data and operations potentially transparent to all.
Not For Attribution	4	CALSIM II data is all in the users' hands and not hidden in the code. Any user can create the input files very quickly.
R Brown	4e	Each node in CALSIM II can represent a number of features, not all of which are transparent to the user (ex. SWP Pumping Facility represents not only the SWP pumping, but also CVP wheeling, EWA pumping, water transfers, Article 21 water).
Not For Attribution	4	CALSIM II is more transparent and versatile than PROSIM was.
Wilkinson	4h	CALSIM II is transparent but not accessible or user-friendly.

Simulation vs. Optimization

Summary Lead	Comment Number	Comment
Link	4e	CALSIM II uses an LP solver, but it is structured with a FORTRAN mentality. The full LP capabilities are not being utilized.
Link	5d	LP capabilities should be used. Several operating goals could use multi-period optimization (e.g., B2, EWA, and temperature).
Shum	4e	It is not clear how the LP solver is used in CALSIM II, and if optimization is part of the algorithm. If optimization is used, the properties of the objective function would need to be better understood. It is possible that the objective function has a "flat surface" that would render solutions in individual months subject to large changes when model inputs or model parameters are changed even slightly.
Shum	5e	It is not clear how the LP solver is used in CALSIM II, and if optimization is part of the algorithm. If optimization is used, the properties of the objective function would need to be better understood. It is possible that the objective function has a "flat surface" that would render solutions in individual months subject to large changes when model inputs or model parameters are changed even slightly.
Not For Attribution	9	He is really impressed with the work that has been done to this point, especially the addition of the optimization language into CALSIM.
Hilts	4f	Unable to see the benefit of an optimization approach to simulate the highly constrained CVP/SWP system. Believes specifying rules in the model as rules rather than constraints may make results easier to explain to managers. Believes using the optimization route,

		with its weights and penalties approach, increases the numerical overhead and may obfuscate the interplay of competing objectives.
Fullerton	5a	PH is interested in seeing a better integration of CALSIM II into MWD's IRP Monte Carlo model.
Fullerton	5d	DF would like to be able to see the Monte-Carlo approach that is currently used for the MWD system extended to CALSIM II.
Fullerton	5e	DF would like to use CALSIM II in an operations mode and to be able to perform statistical analysis for operations issues, following branching patterns of decisions and probabilistic events.

Other

Summary Lead	Comment Number	Comment
Not For Attribution	4	Likes the concept of the tool very much. Sees potential for applying CALSIM software to other basins.
Not For Attribution	4	The software and numerics are strong.
Wang	4d	CALSIM II is much easier to represent many constraints than DWRSIM.
Fryer	4e	The software is better than it was before.
Meyer	4f	It seems that CALSIM II uses a lot of the old DWRSIM logic and does not take advantage of the new software capabilities.
R Brown	5d	This model could be converted to a “spreadsheet format” model. One page clearly listing the assumptions, one page containing the input data and one page containing the results. “Everything” would be in a single file.
Not For Attribution	9	There is confusion between CALSIM (the software), and CALSIM II (the model of the CVP/SWP system).
Not For Attribution	4	CALSIM II is data-driven.
Not For Attribution	4	The GNU public license requires that modifications to the model software become public domain.
Munevar	5b	A weight pre-processor such as the one used in MODSIM where priorities are specified and the pre-processor generates weights.
Munevar	5e	Multi-period optimization capability with different drivers would be useful, especially for defining new allocation rules.
Meyer	4c	CALSIM II has a “cycle” capability that enables the model to simulate either a portion of the system or the entire system under a specific set of assumptions and base subsequent “cycles” on the results of a previous “cycle”.
R Brown	5b	The model needs to be re-structured to jointly run a base and an alternative scenario and have the model automatically echo out the differences in assumptions in the two runs. These differences need to be seen easily, preferably in a visual format. CALSIM II is a comparative model, but there is no easy way to make an incremental analysis. Each model run requires a separate directory with all the input files. The process is time consuming and prone to error.
Rosenkranz	5d	Would like to have CALSIM II output mass balance for every node in the schematic.
Bourez	4m	The FORTRAN translator is a problem.
Meyer	4d	The use of the FORTRAN compiler during run time is cumbersome and unnecessary.
Sheer	4d	The need for a FORTRAN compiler is awkward. Eliminating the need for this compiler would require re-writing the model software.

APPENDIX F: SUMMARIES FOR ATTRIUBTION

The following appendix contains the written summaries for the 48 interviews conducted for attribution. The answers to questions #7 and #8 were omitted.

CALSIM II Interview Summary

INTERVIEWEES: Tom Boardman
AFFILIATION: San Luis-Delta Mendota Water Authority (SLDMWA)
DATE: May 27, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. He is primarily a user of CALSIM II results. He interprets and post-processes results for the SLDMWA Board.

b. In the past he used PROSIM and Reclamation's 12-month operations spreadsheet model.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. CALSIM II results are used to evaluate the effects of regulatory actions on water supply primarily

b. He uses runs done by agencies or consultants and is typically interested in results pertaining to 15 to 20 CALSIM II nodes. Output of interest includes CVP deliveries, Shasta carryover storage, Trinity basin, Delta surplus flow, and extra capacity at Banks.

c. He post-processes CALSIM II results to evaluate the opportunities of moving CVP water or surplus water through the State's pumping facility.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. CALSIM II will be used to perform the types of studies listed under 2) for as long as the agencies are focused on it.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. The monthly time step is too large. The time step should be at a minimum weekly, and perhaps daily. A shorter time step would better capture the hydrologic variability that occurs during the year (e.g., spring months).

b. CALSIM II is a powerful model designed to simulate a very complex system. However, this should not come at the cost of ease-of-use. The WRESL language is very cryptic. CALSIM II is difficult to modify even for very simple analysis. Changing WRESL code in one part of the model could cause conflicts in other parts of the model if the user is not adept with CALSIM.

c. There are very few people that can run CALSIM II with reliable results. The pool of consultants that use CALSIM II is very small. With a large number of stakeholders, the potential for conflict of interest is large.

d. The ANN appears to overestimate the amount of water needed to satisfy regulatory requirements in the Delta.

e. Groundwater representation might need to be improved.

f. Operating rules and north-of-delta demands are not easily modified.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. CALSIM II should be developed so that stakeholders can run it without using consultants. Ease-of-use should be a priority.

b. CALSIM II documentation must be improved. There should be as much effort placed on documenting CALSIM II as on developing it.

c. Easily accessible technical support.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Probably PROSIM, as it represents the CVP better than DWRSIM.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

CALSIM II Interview Summary

INTERVIEWEES: Walter Bourez and Ben Tustisen
AFFILIATION: MBK Engineers
DATE: June 4, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Involvement includes extensive PROSIM and DWRSIM use and development.

b. Developed the first hydrology used in PROSIM.

c. Familiar with Program 164, the precursor to PROSIM.

d. Used PROSIM in numerous negotiations, policy analyses, proposed project analyses, litigation, and environmental documentation.

e. Obtained the first public release of DWRSIM in 1990. Used DWRSIM extensively over the years for a numerous studies.

f. Involved in the Benchmark Study Team and the Technical Coordination Team.

g. Rebuilt the San Joaquin River basin for CALSIM II and helped with the development of demands for CVP south of the Delta.

h. Part of team that revised the entire San Joaquin River basin and its land-use based demands. Met with every district in the basin to find out how to best represent their demands and water use in CALSIM II. Became the interface between the districts and CALSIM II.

i. Performed CALSIM II validation run for the San Joaquin basin.

j. Currently using same methods to improve Sacramento River basin representation.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Improve the hydrologic representation of the entire Sacramento and San Joaquin basins.

b. Trying to rationalize and standardize hydrology and demands, with a new definition of Depletion Study Areas (DSAs).

c. CALSIM II results used for various studies on the San Joaquin River, for models used to evaluate South of Delta storage, input for gaming models for the San Joaquin River, EWA, CVP water supply improvement plan, CVP contract renewal studies, and CALFED studies.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Future uses of CALSIM II include using model results for more localized studies and any analyses that affect the Bay-Delta.

b. CALSIM II will be used with other models such as DSM2 for analysis of In-Delta Storage.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. Rather than start from scratch, initial CALSIM development concentrated on trying mimic previous models. Many of the problems with DWRSIM, PROSIM, and SANJASM were brought to CALSIM II. It has taken a while to get out of "modeling the model" mode and to start modeling the system.

b. Hydrology in the Sacramento River basin was developed in the early 1960's. Although the methods and level of detail was adequate at the time of development, the model is being used to evaluate more complex questions, which pushes the use of the hydrology beyond the point of accuracy. Much of the hydrology is lumped (spatially) in the Sacramento basin and should be refined to be commensurate with the level of detail in CALSIM II and the analysis being performed.

c. DSA basin efficiencies are way out-of-date. "No question that they are too low".

d. Rice decomposition demands are not represented in CALSIM II. Rice operations need to be revised.

e. Need to better model Refuge demands. Agricultural efficiencies are used and ponding operations are not included.

f. CALSIM data development is weaker than the representation of operations.

g. CALSIM II is driven by weights. Although this is a powerful tool, the user has to think in terms of LP to be able to use CALSIM II.

h. One needs a lot of experience with CALSIM II and knowledge of the system to be able to use CALSIM II.

i. It is hard to track infeasibilities with CALSIM II.

j. Most CALSIM II documentation is in a few people's heads. Work is currently being done to improve the documentation.

k. The LP solver is unstable, costly, and requires a "dongel" to run.

l. Input data is weak (see above).

m. The FORTRAN translator is a problem.

n. There is no model calibration, although DWR is currently working on this.

o. The groundwater representation is very weak, DWR is currently working on this overwhelming task

p. CVP and SWP allocations through the WSI/DI (water supply index/delivery index) curves are difficult to work with and do not reflect the operator's decision-making process, DWR and Reclamation are currently working on this issue.

q. The use of the ANN for salinity has been problematic. Small changes in flow in the Delta seem to trigger large change in operations.

r. CALSIM II is very versatile. It lends itself to being able to incorporate almost anything, but calibrating the weights can be very difficult.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Fix the problems listed above.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. PROSIM or DWRSIM. At this point these models are inferior to CALSIM II in terms of representation and data.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

CALSIM II development is headed in the right direction, but some hurdles remain. It is important to get people to understand that it is necessary to understand the system to be able to model it with CALSIM II or any other model.

CALSIM II Interview Summary

INTERVIEWEE: Paul Brown
AFFILIATION: CDM
DATE: August 5, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Does not work directly with CALSIM II or other similar models. He uses higher level, more general and less detailed modeling packages such as STELLA and EXTEND to help inform policy-level planning for clients throughout California on a variety of subjects.

b. Served as facilitator of the CALFED Water Management Strategy Evaluation Framework in 1999. This effort focused on the development of performance indicators with which to evaluate proposed alternatives. A group of linked models was intended to inform this process, but failed to produce results that were timely enough to contribute significantly to the final policy conclusions.

c. Has worked with Metropolitan Water District on its Integrated Resource Plan, including using results from its IRPSIM model, which incorporated results (or rule curves) from CALSIM II and other hydrodynamic models.

d. Was project director for City of San Diego Water Resources Plan, where a STELLA model was developed and applied to determine a preferred long-term water supply strategy. This model incorporated results (or rule curves) from other models such as MWD's IRPSIM model and CALSIM II.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Does not use CALSIM II himself.

b. Important to match the model to the question, rather than seeing all questions through the framework of the available model.

c. A detailed hydraulic and hydrologic model such as CALSIM II is appropriate and necessary to examine the detailed effects of specific changes in facilities and operations.

d. For broad-scale, planning questions, a less detailed, bigger picture model can provide "adequately precise" rule curves and guidance with which to eliminate most alternatives and focus more detailed analyses on a few good alternatives. Such a model has the benefit of incorporating other performance

measures (e.g., cost, water quality, environmental impacts) in more holistic, integrated fashion.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Hopes that people do enough work on California's "plumbing" and the institutions that control it, so that detailed models such as CALSIM II will be used frequently.

b. Having the right tools at the policy/ planning level will facilitate the detailed analyses for which CALSIM II is both needed and well-suited.

c. It is crucial to generate results in a timely enough fashion that they can be used (i.e., before a decision must be made).

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II is a "remarkable accomplishment" that performs many functions better than any other hydrodynamic simulation model. California is fortunate to have such a tool.

b. It is better for detailed models to stand alone and then feed into larger models than to "wire together" many models and run them all at once for general policy purposes.

c. Among detailed models in general, the interface between surface water and groundwater models tends to be weak.

d. Impressed with CALSIM II but skeptical of some purposes to which people are trying to apply it.

e. No matter how good a tool is, it is important to define the problem appropriately based on clear objectives before modeling even begins.

f. Application of a model to a problem for which it is not suited can "undermine" a good tool and make it look bad. This does not mean that the tool is weak, but that it should be used appropriately.

g. There is currently a "disconnect" (and sometimes distrust) between those who use coarser, policy level models vs. detailed, specific models. Both types of model should be seen as complimentary rather than mutually exclusive and competitive. The distrust that often exists between users creates unnecessary conflict similar to disagreements that existed regarding DWRSIM vs. PROSIM. This is an unnecessary and counterproductive barrier to innovative use of these tools.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. California has significant geographically focused information about specific groundwater basins and has broad information about surface water across the state. It will be necessary to connect both worlds effectively for future planning.

b. The modeling community could benefit from informed generalists who can be objective and can differentiate between applications to which a model is or is not suited. It is easy for individuals who are deeply involved and invested in a model to see all problems in terms of that model's capacity to address them, often forgetting to evaluate the suitability of applying that model to that question.

c. Using a good policy/planning level model could facilitate the detailed analyses for which CALSIM II is necessary. Having two tiers of models (detailed and low- resolution-but-broad) could help CALSIM II perform its intended function better and more efficiently.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. He uses other models for policy planning purposes, including STELLA and EXTEND. However, if CALSIM II were not available, policy models would be more difficult to develop because CALSIM II provides many of the working rule curves for estimating imported water deliveries under different hydrologic conditions.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

As mentioned above, there are many different types of models used for different purposes. There are models well suited for strategic level decisions, tactical planning, and operations. CALSIM II represents a good model for tactical planning, that is a model to help planners and operators understand the State Water Project and CVP system under different hydrologic and operating scenarios. However, a statewide strategic level model is lacking. Such a model would be able to integrate the many facets of water resources such as supply reliability, cost, water quality, environmental impacts, and public acceptance in a more holistic and comprehensive fashion. A strategic model would compliment CALSIM II, and in many ways make it stronger as there would be less temptation to use the model for purposes other than those for which it was intended.

CALSIM II Interview Summary

INTERVIEWEE: Russ Brown
AFFILIATION: Jones & Stokes
DATE: May 9, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. They are users of models, including DWRSIM and PROSIM.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. They use models for Environmental Impact Reports (EIR) and Environmental Impact Statements (EIS).

b. They use results from CALSIM II as inputs into the USBR monthly water temperature models, and Delta hydrodynamic and water quality models (Fisher-Delta model and DSM2).

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. They will continue to use CALSIM II for EIR/EIS, fish protection studies, new project analysis, and water resource allocation evaluation.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. The strongest feature of CALSIM II is the hydrology data set (the "Joint Hydrology") that had to be created to run the model. The state and federal agencies now have a common, agreed upon set of hydrologic inputs. But these inputs should be updated for recent years (i.e., 1995-present).

b. CALSIM II lacks basic groundwater representation (i.e., stream/river-shallow groundwater relationships). CVGSM attempted to determine the historic groundwater levels (in the Central Valley), but this was not included directly in CALSIM II.

c. One of CALSIM II's strengths is its' flexibility. It is object oriented and has an open architecture. It is possible to add or modify operating rules and to add new facilities to the model.

d. One of CALSIM II's weaknesses is its' flexibility. Model users can add any feature they want, so that there can potentially be many different versions of the model being used simultaneously. And these versions seem to be "drifting apart." There is no standard (i.e., official) version of the model, even though the hydrology is now standardized.

e. Each node in CALSIM II can represent a number of features, not all of which are transparent to the user (ex. SWP Pumping Facility represents not only the SWP pumping, but also CVP wheeling, EWA pumping, water transfers, Article 21 water).

f. The representation of the San Joaquin River tributaries and Mokelumne Reservoirs have been "hard-wired" rather than simulated with standardized demands and operating rules.

g. The Yuba River system is not represented in CALSIM II, so the potential for water transfers cannot be evaluated directly.

h. CALSIM II model results alone are not sufficient to document modeling; the entire input structure is needed to see what assumptions were made.

i. CALSIM II results are stored in DSS, which does not have a standard (user-friendly) tool for spreadsheet "interaction." Also, the results files are "huge." DWR's DSS GUI only allows for extraction of one variable at a time, which is inefficient.

j. It is not easy to "see" CALSIM II results. The user interface is not much better than the one in DWRSIM.

k. CALSIM II operates on a monthly time step, but many features (ex. reservoir and Delta operations) occur only a shorter time step (ex. daily or weekly). System features such as EWA, VAMP, flood control, fisheries, and Delta requirements cannot be adequately analyzed with a monthly model. Presently there are "duct-tape efforts to try and work around the monthly time step," but linking daily sections within monthly models is not a "good foundation" for modeling efforts.

l. CALSIM II uses the 1922-1994 time series of hydrologic inputs, but there has been no attempt to calibrate the model to historic operations in the Central Valley. The model output should match important features of the real system for recent years

m. CALSIM II does not have a temperature module, so this important step must be done by hand afterwards. Sometimes the reservoir storage or release values must then be "adjusted" to give more acceptable temperature results. The temperature calculations should be integrated with CALSIM II.

n. There is a lack of documentation on the required input files. There are many input files required for a CALSIM II run, but not all of the files have documentation.

o. CALSIM II is a comparative model, but there is no easy way to make an incremental analysis. Each model run requires a separate directory with all the input files. The process is time consuming and prone to error.

p. There is no feedback on demands in the model. CALSIM II assumes fixed annual demands that do no reflect the hydrologic conditions.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Create a user interface that would allow the user to click on a node and see a list of the features associated with the node. (See 4e for details.)

b. The model needs to be re-structured to jointly run a base and an alternative scenario and have the model automatically echo out the differences in assumptions in the two runs. These differences need to be seen easily, preferably in a visual format. (See 4o for details.)

c. The model should be validated with the last 25 years of hydrology (including running the model for1995-2003).

d. This model could be converted to a "spreadsheet format" model. One page clearly listing the assumptions, one page containing the input data and one page containing the results. "Everything" would be in a single file.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. A spreadsheet model based on historic daily and monthly data.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. No.

CALSIM II Interview Summary

INTERVIEWEE: Grace Chan
AFFILIATION: Metropolitan Water District (MWD)
DATE: May 8, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Personally, she has not directly used CALSIM II, but she has looked at results. MWD uses output from CALSIM II as input into their models. MWD uses CALSIM II results for the IRP (Integrated Resource Plan) and to evaluate CALFED alternatives.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. MWD uses CALSIM II results for their IRP. Results are used to determine how much water would/could be delivered from the SWP. They are using CALSIM II in a "predictive mode."

b. MWD uses CALSIM II to compare alternative CALFED options. In this way, they use CALSIM II in a "comparative mode."

c. They also use CALSIM II in conjunction with other models, such as IRPSIM and IRPDSM, and other DWR models (DSM2, Fischer-Delta model).

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Aside from the current uses, she not does anticipate future additional uses.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. MWD keeps using CALSIM II because it is "probably the best framework" for the projects (CVP and SWP). It takes into account the upstream users and the Delta standards. CALSIM II has a "long history" and up until recently it has been a "consensus model."

b. A criticism that she has heard is that the model does not quite characterize the operations of the system in the same way that the operators would operate the system.

c. Whenever there is a change it seems to take DWR a long time to capture the change. It is "very frustrating." An example is the Bay Delta Accords. Each time DWR modified the model, the project yield would change. This leads to a problem with credibility of the model.

d. CALSIM II seems to have too much emphasis placed on being only a comparative model and does not seem likely to "settle down" enough to be used consistently as a predictive model. This makes the calibration and validation seem weak.

e. She has heard that CALSIM II does not analyze water transfers. CALSIM II needs to be able to capture potential water transfers better.

f. CALSIM II demands are based on climate. For MWD the modeled demands are highest during the dry periods and lowest during wet periods. In practice, MWD demands are highest in the wet periods because they want to fill storage facilities. CALSIM II needs to be able to better model demands based on actual demands.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. DWR needs to do a calibration and validation exercise and publish the results.

b. Decrease the run time. Currently the data transfer is not efficient.

c. DWR needs to spend more time on scenario analysis and less on "tinkering" because it is difficult to get support for scenario analysis.

d. CALSIM II has variable hydrology, but assumes a static level demand and facilities, which makes it not very good at modeling the future. The ability to have time-varying demands and facilities would be beneficial for MWD's purposes, and make the model more like IRPSIM.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. MWD would develop in-house models.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) *Who else should we talk with about CALSIM II?*

9) Is there anything else you would like to add regarding CALSIM II?

a. DWR should have a user group (that meets relatively infrequently, once a year perhaps) to exchange ideas on how to use the model and what improvements are needed.

CALSIM II Interview Summary

INTERVIEWEE: Martha Davis
AFFILIATION: Inland Empire Water District (IEWD)
DATE: May 28, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Mostly indirectly, via model output incorporated by DWR or CALFED into various documents such as Bulletin 160-98 and CALFED comparisons.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. IEWD does not use CALSIM II at all. In theory, CALSIM II information would come from DWR in the form of the SWP Reliability Study. Currently, however, IEWD would not use the SWP Reliability Study as 70% of the district's water supply comes from local sources. Indirectly, however, MWD provides estimates for our local planning from MWD's own model, that likely uses CALSIM II numbers.

b. According to MWD's report, there is ample water supply from the SWP, Colorado River and local projects to sustain new development.

c. Expects lawsuits testing the basis for findings of adequate water supply. "Paper water" is not a good enough basis for development to go forward. Additional model scrutiny is anticipated as a consequence of using loose numbers in water supply and availability forecasts.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. The questions being asked of CALSIM II have changed since it was originally developed. It is not a good idea to use CALSIM II as a predictive tool without testing it for that purpose. The use of CALSIM II as a predictive tool makes DWR's credibility vulnerable.

b. Bigger questions are being asked than just those concerning the Bay-Delta. DWR cannot afford to have a Delta-centric model, as it clearly cannot address current policy questions in California.

c. Tighter numbers are now important and will become more important for compliance with legislative requirements to assure water availability for new land development. There is now a clear nexus between water availability and

land development. It must be possible to defend water availability calculations against legal challenges.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II was originally designed as a comparative tool. People seem more comfortable with the use of CALSIM II in comparative mode. However, the comparative vs. predictive nuances in CALSIM II's original intensions are no longer necessarily relevant. A predictive tool is needed now. The questions asked of models have changed.

b. What is needed now is a predictive tool that helps us understand the system. For instance, to be able to evaluate water transfers, we need to understand how much water there is and where it is in the system. Such a model must replicate and account for system operations.

c. CALSIM II must be tested for predictive purposes. Biases must be identified and the reliability of results established. If absolute numbers appear "goofy" it is important to determine if there is a problem with the input data, the assumptions used, or the model itself.

d. For the Bulletin 160-98, CALSIM II used southern California demands that were 1 MAF higher than they actually are. Such overestimates of demand skew policy conclusions.

e. Assumptions about infinite groundwater pumping are unreasonable.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Validation of CALSIM II is required to determine whether or not there are systematic biases in the model. Most people think that CALSIM II over-predicts Delta exports.

b. CALSIM II results must come close to simulating historical data. What does it take to validate a model for predictive purposes? The Mono Lake model was calibrated based on 50 years of data. Historical comparison is important.

c. Because so much work has been done with CALSIM II, there is reluctance to admit that there is a problem with the model. Conclusions seem unhedged and sometimes strain credulity. We need to determine and state what is working and what is not working so that we can move forward and justify resource expenditures for improvements. We need to "commit truth" when problems are evident.

d. The SWP needs a Delta-centric model, but for broader California water policy a better set of models is needed to show how state, regional, and local facilities and options best go together.

e. The question is: How do local, regional, and state facilities and options best go together? We need information, data, and systems at all scales.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Not currently using CALSIM II

7) For your organization, who inside or outside your organization: (name and affiliation)

8) *Who else should we talk with about CALSIM II?*

9) Is there anything else you would like to add regarding CALSIM II?

It is extraordinary how poor our understanding is of California water, groundwater, water quality, etc.

CALSIM II Interview Summary

INTERVIEWEES: Richard Denton (RD) and David Briggs (DB)
AFFILIATION: Contra Costa Water District (CCWD)
DATE: May 13, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. CCWD used DWRSIM in the past, and has analyzed modeling by others using PROSIM and DWRSIM but has yet to run CALSIM II in-house. Their consultants have run CALSIM II, however.

b. RD used DWRSIM in the environmental analysis of CCWD's Los Vaqueros project and to provide input data to the Fischer Delta Model and CCWD's salinity-outflow model (G-Model) for modeling Delta water quality.

c. DB was involved in the implementation of the G-Model in DWRSIM.

d. Both RD and DB use output from CALSIM II, such as surplus flows and net Delta outflow, as input for other models.

e. CALSIM II will be used by the CCWD CALFED Group to simulate an expanded Los Vaqueros Reservoir.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. CCWD's primary use for CALSIM II is as part of evaluations of the effects of various Bay-Delta projects on CCWD's water quality and water supply and on the Delta ecosystem.

b. CCWD uses CALSIM II output as input to other models, including:

- hydrodynamics and water quality models, primarily the Fischer Delta Model, but also DSM2 for CALFED studies;
- salinity-outflow models (G-model)
- CCWD's local operations model, CCWDOps; and
- Other modeling efforts related to Los Vaqueros Reservoir operations.

c. CALSIM II does not provide detailed information on operation of CCWD's Los Vaqueros Project because it treats CCWD's three Delta

intakes as a single diversion point and does not model Los Vaqueros Reservoir operations.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. DB foresees the need to model water transfers, although he expects that it will be difficult to trace project vs. non-project water and transactions.

b. RD anticipates new modeling runs, likely using CALSIM II, in response to the upcoming periodic (triennial) SWRCB review of Bay-Delta standards.

c. Until now, SWRI has been using DWRSIM to evaluate the CALFED Los Vaqueros Reservoir Expansion Project. However, for the next round of studies, CCWD will be using CALSIM II. This may require that CALSIM II be modified to better represent CCWD's three Delta intakes and possibly Los Vaqueros itself.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II represents the CCWD CVP diversions from the Delta in the same way that they were modeled in DWRSIM, that is, as a time-series of CVP diversions provided by CCWD (shortages are not dynamically applied, they must be pre-preprocessed as input). CALSIM II should be modified so that CCWD diversions are dynamically calculated in the model taking into account both CCWD's CVP allocation. This error will become more pronounced as CCWD's use of CVP water increases if it is not addressed.

b. DB sees the need for CALSIM II to characterize CCWD diversions using two flow arcs, rather than the current single arc. The two arcs would represent the two distinct types of water available to CCWD from the Delta: CVP water and Los Vaqueros water rights to Delta surplus water. Because the Los Vaqueros diversion is lumped with the diversion of CVP water, the computation of Delta surplus water is incorrect in CALSIM II. If two flow arcs are used, CCWD's operation of Los Vaqueros Reservoir to improve the quality of water delivered to its customers can be better simulated. When CCWD is releasing water from Los Vaqueros for blending in drier periods, CCWD's Delta diversions are reduced. When CCWD is filling its reservoir in wetter periods, CCWD's Delta diversions are increased above its direct service area demands.

c. DB would like to see further refinement of the accretions analysis in CALSIM II. Some of CCWD's raw water customers and CCWD's use of its own Mallard Slough water rights result in direct diversions of water from the Delta in wet years, when the water quality is good. This affects CCWD's demand

from other sources (such as the CVP and Los Vaqueros water sources) and Delta depletions should be adjusted accordingly. CALSIM II does not presently reflect this (although this adjustment may be small relative to the overall Delta depletions).

d. RD is interested in a better ability to model salinity-outflow requirements and noted that the existing salinity-outflow model in CALSIM II appears to need different model calibrations for different regulatory requirements (D1485, D1641, B2, EWA). ANN results are not consistent over the different regulatory scenarios. RD understood that in some cases, D1485 would cost more water than more stringent requirements, which does not make sense. He hopes that the current CART process will be able to resolve these issues.

e. CALSIM II should be able to address questions regarding the effects of global warming and to be able to model "more realistic" future scenarios and modified hydrologies, such as those being developed by Jim Cloern (USGS).

f. Timesteps of less than one month (1-2 weeks) apply better to actual conditions and more realistically represent actual operation changes.

g. CCWD would like CALSIM II to include water quality, not just for purposes of meeting Delta standards, but also to capture preferences for when to export.

h. RD wonders about the need to plan for more realistic and/or extreme droughts, perhaps by using stochastic hydrologies. Some water agencies have developed their own drought planning sequences that are much more severe than recent historical droughts.

i. RD expressed concern regarding CALSIM II's ability to realistically reflect dry-year operations. He believes that, in future and past drought years, actual drawdown of reservoirs has been less than that depicted in the model because of Drought Water Banks and fallowing and groundwater pumping by upstream water users. Similarly, CALSIM II needs to more accurately account for use of Delta export pumps for Joint Point and water transfers.

j. CALSIM II must be able to track project and non-project water so that water transfers can be adequately evaluated.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. RD would like to see a more involvement of stakeholders in development of CALSIM II and more opportunity for training and education, including the creation of a CALSIM II users' group. Participation by DWR and Reclamation in such a user group would be essential.

b. DB would like to see the use of a free Linear Programming solver and expressed concern about investing in an expensive commercial LP solver when there is no guarantee that that solver would continue to be used.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. DWRSIM or PROSIM.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

No.

CALSIM II Interview Summary

INTERVIEWEE: Terry Erlewine
AFFILIATION: State Water Contractors
DATE: May 30, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

b. Has not had much direct involvement with CALSIM II. He has reviewed and looked at results from CALSIM II and DWRSIM.

c. Worked at DWR on DWRSIM predecessor on model development/program, performing operations studies, and on the development of the hydrology data.

d. Developed the hydrology for a Yuba River model while consulting.

e. Worked on groundwater modeling in the San Joaquin Valley.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

c. Normally, either consultants or DWR staff do the actually modeling. He uses CALSIM II to identify potential improvements in water operations, study proposed concepts and evaluate alternatives.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

b. Future use of CALSIM II would be about the same as in 2). Primarily work with DWR on many things, including operational policy studies.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration,

software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

q. Interface between real-time operations and CALSIM II is a concern. SWP real-time guidelines are not included in the model. Some of the operational practices seem beyond the existing capabilities of CALSIM II. For many, probably most applications (especially comparative), this is probably not a problem. Where it gets to be a problem is when we try to look at how complicated operational approaches could affect/improve project yield.

   - Carryover contracts are not included. CALSIM II does not allow contractors to carryover contract storage from year-to-year.

r. The forecast probability data used to make contract allocations in CALSIM II for each month is not very accurate. The data is not nearly as good as the data available to real operators. Allocations can be inaccurate (not biased over or under on average, just inaccurate).

   - The model takes the runoff and uses the probabilities to determine what volume of water will be available for allocation over the next water year. It does not include the snowpack that actual operators see, so it could miss-estimate the available water in high or low snowpack years.

s. Usability is an issue in CALSIM II. DSS makes it difficult for users to obtain and understand results from a model run. Users should be able to access results in an ASCII text file format. Also, there needs to be a way to easily access "standard results" (i.e., those flow, storage, or delivery results that are of interest most commonly).

t. CALSIM II does not include year-to-year variation in ET (evapotransipiration).

u. CALSIM II needs to be tied in with CVGSM, to include groundwater.

v. The data availability is a limitation.

w. Not convinced that the Sacramento Valley depletion areas (for hydrology) are modeled well, especially in terms of representing demands and groundwater. Perhaps in the Sacramento Valley, water supply sources should be used rather than drainage areas. Can the depletion areas better match well-known data, gages, irrigation districts, etc.?

x. Questions need for or value of model. How do you calibrate an operations model for future operations that have never occurred? In most cases, your current and future operations differ from historical operations, making a comparison pointless.

y. The time step is too large. For example, CALSIM II cannot represent surplus flows accurately, which effect pumping, export and storage capacity in the system.

z. DWR over-emphasizes the importance of CALSIM II. The result is that the model is used inappropriately, mostly because it is the only tool available. There are times when using CALSIM II is not necessary, yet it is still used.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

e. An improved interface between real-time operations and the model is needed.

f. Ability to access and use the output data could be improved, as outlined above.

g. Improved representation of contractor behavior would be useful. However, this might cause additional problems, because contractors will not want to be second-guessed by the modelers.

6) If CALSIM II were unavailable for your purposes, what would you use?

b. PROSIM or DWRSIM

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

There is generally no policy demand for modeling. To suggest modeling is often seen as a "stall" tactic.

CALSIM II Interview Summary

INTERVIEWEE: Lloyd Fryer
AFFILIATION: Kern County Water Agency
DATE: May 12, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. His involvement has been as a user of results.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. He uses CALSIM II results as input to KCWA water supply and distribution studies.

b. KCWA uses a sophisticated spreadsheet model that takes CALSIM II output and splits and distributes KCWA simulated deliveries among the various member agencies. This operations model includes priorities, water accounts, and conveyance priority and availability. These studies are generally performed in the fall of each year to set up contingencies for the coming year.

c. Every five years, KCWA performs delivery reliability studies for member agencies. Results from the reliability studies are then used by the individual member agencies in their internal analysis, enabling them to make decisions regarding conjunctive use and water banking.

d. KCWA also conducts financial studies that use CALSIM II results. These studies are conducted either annually or biannually, and help determine the financial implications of using ad valorum tax revenues for several purposes, including the financing of projects and to prevent SWP water becoming more expensive than the cost of pumping groundwater.

e. Bob McKusick of Northwest Economic Associates runs CALSIM II results through economic models (CVPM model).

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. He anticipates developing a spreadsheet version of the KCOM model of the Kern County water system originally developed by Betty Andrews. This model would use CALSIM II results and route it through the KCWA distribution system to identify bottlenecks and possible infrastructure improvements.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. He is not too sure of details of CALSIM II to be in a position to comment on strengths and weaknesses.

b. Time step is too large.

c. Exports simulated by CALSIM II are "a bit on the high side". In KCWA studies, CALSIM II deliveries are discounted by approximately 10 percent. While PROSIM studies showed approximately 65% of full deliveries for long-term studies, CALSIM II shows close to 73% of full deliveries.

d. The quality of the input data seems to be "pretty good".

e. The software is better than it was before.

f. Guidance on how to use the model is poor.

g. Model calibration is a commonly heard concern, but seems to be a "distinction without a difference". Specific year differences are to be expected in this type of model. It will be hard to ever get it exact. For this reason, he would not expect to use CALSIM II for real-time operations purposes. It is a more realistic model for planning purposes and long-term reliability studies. For our purposes, CALSIM II results are adequate to analyze how well banking projects will operate over long, dry periods and how groundwater can be used to eliminate bottlenecks in the system. He believes that people are over-emphasizing the need for calibration to historical data.

h. The operating rules are likely to be outdated by the time they get implemented in the model. This appears to be the case with EWA and take limits.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. It would be ideal if DWR could hold fairly intensive training classes. SWP contractors would like to be able to perform CALSIM II studies themselves.

b. Understandable documentation (in the form of a DWR bulletin) on CALSIM II input data and operations rules, including the decision logic is needed.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Dave Schuster, as he had a good understanding of the Delta and the system as a whole.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. He would like to see a CALSIM II with a smaller time step. A daily time step would be ideal to analyze Article 21 water availability and the daily operation of local facilities.

b. Because operations have become orders of magnitude more difficult over the last 20 years, it is important to have a tool that can help analyze the system quickly.

CALSIM II Interview Summary

INTERVIEWEE: David Fullerton (DF) and Paul Hutton (PH)
AFFILIATION: Metropolitan Water District
DATE: May 7, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. While at DWR, Paul Hutton led DWRSIM studies group, including early Phase 8 studies. Later on, he was very intimately involved with the ANN implementation in CALSIM II.

b. David Fullerton worked closely with Armin Munevar to develop the five-layer simulation procedure of CALSIM II, particularly the EWA layer.

c. DF has used CALSIM II and its predecessor DWRSIM for a number of processes and projects, facility planning and operation studies including the 1994 Bay-Delta Accord, project yield, and Sites Reservoir.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. DF uses CALSIM II to get in the "ballpark", as an initial estimate, and then conducts spreadsheet post-processing analysis. DF believes that CALSIM II is too unwieldy to perform more detailed analyses.

b. Typically, DF perturbates CALSIM II runs using spreadsheets.

c. PH uses CALSIM II output as input to Delta hydrodynamics models.

d. PH uses CALSIM II for operations and delivery allocation planning studies.

e. While at MWD PH has looked into facility analyses done directly with CALSIM II or with additional post-processing of CALSIM II results.

f. Others at MWD use CALSIM II results as input to the IRPSIM model.

g. DF has post-processed CALSIM II results for additional analysis, particularly in gaming exercises including EWA game, water quality game, Sites Reservoir game, and CVP capacity game.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. For climate change scenario studies, the hydrology needs to be more flexible, including seasonal shifts in runoff.

b. PH anticipates using CALSIM II to improve water quality forecasts for operations, both real time and operations planning studies. Water quality must be included in decisions regarding pumping from the Delta to improve combined quality and quantity of water.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II is too unwieldy with too long of a turn around time for detailed analysis.

b. CALSIM II is too complex to be easily upgraded to analyze different scenarios.

c. CALSIM II is not able to track "water with different names".

d. CALSIM II does not simulate carryover storage and transfers among users.

e. EWA is poorly portrayed in CALSIM II. Additional effort is needed to correlate environmental performance to hydrology. Currently, EWA runs are fairly speculative regarding the actions that would be taken. EWA is modeled as described in the ROD, and not as it is operated in "real life".

f. The monthly time step in CALSIM II results in biased results, in some cases by as much as 100 to 200 thousand acre-feet per year additional pumping. It is much easier to meet standards in a monthly model. A shorter time step is needed. The EWA gaming exercises showed that the monthly time step is a problem, particularly with regard to Delta operations. A weekly time step, although not ideal, would be a great improvement.

g. The representation of Article 21 (Monterey Agreement) water is very crude. Locally developed storage and treatment options have resulted in demand for Article 21 water to be greater than previously estimated. This is a very important effect that is not captured in CALSIM II.

h. PH believes that the implementation of the ANN is still in its infancy. Further improvements in the ANN representation and integration of Delta water quality should be a high priority. "A lot of improvement is still to be had".

i. Although it is a "big and clunky" model, DF believes that there is some advantage to having a single model that is used by everyone. PH agrees and adds that there is a great value in having a common state and federal model, as modeling efforts have become more productive.

j. DF finds it hard to obtain desired CALSIM II runs. He finds the model hard to set up, check, and get results.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. PH is interested in seeing a better integration of CALSIM II into MWD's IRP Monte Carlo model.

b. PH believes that a GIS method should be developed so that changes to hydrology due to land-use can be better and more easily incorporated. Such a methodology would also help the analyses of water transfers.

c. DF would like to see groundwater more fully integrated in CALSIM II, including programs that include groundwater substitution.

d. DF would like to be able to see the Monte-Carlo approach that is currently used for the MWD system extended to CALSIM II.

e. DF would like to use CALSIM II in an operations mode and to be able to perform statistical analysis for operations issues, following branching patterns of decisions and probabilistic events.

f. PH would like to see hydrology forecasts better represented in CALSIM II. The logic in CALSIM should be more in line with what is done in real-time operations, where inflow is based on snow pack survey results.

g. DF would like to see a comparison of CALSIM II results with real operations in the last ten years. Is the model capable of representing real operations? If model results are different from real operations, why is that?

h. PH would like to see the geographic extent of the model expanded Beyond the CVP-SWP system. CALSIM II should include the Friant-Kern Canal, the Bay Area, and better representation of the Southern California system.

i. DF agrees and adds that CALSIM II also should include conjunctive operations of the Colorado River and Delta exports.

j. The model should be made modular, so that extra features being added could be turned on and off depending on the needs of the model user.

k. DF would like to see a model that is easier to run or to have more people who are able to run it.

l. DF would also like to see a better DSS to Excel data transfer utility, including graphics.

m. PH suggests that a web utility for users so that data can be easily downloaded and statistical analysis on results can be performed.

n. PH also suggests the creation of a users group, perhaps through the modeling forum.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. DWRSIM or PROSIM.

b. Russ Brown's spreadsheet model.

c. May have to develop our own model.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. DF is struck by the crudeness of the computer tools used to analyze water resources in California. Given the multi-million dollar stakes, surely more sophisticated and up-to-the task tools could be developed.

CALSIM II Interview Summary

INTERVIEWEE: Steve Grinnell
AFFILIATION: Montgomery Watson Harza (MWH)
DATE: May 16, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. He has used CALSIM II, HEC-5, DWRSIM, and CVGSM on a number of studies.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. He has used CALSIM II to analyze how to move non-Project water (Non-CVP or SWP) across the State, examining Delta export capacity and water transfer potential.

b. He has used CALSIM II to analyze CVP and SWP deliveries and deficiencies.

c. He has worked on CALSIM II modeling of the Yuba Basin. Initially, DWR converted the HEC-5 model of the Yuba Basin into CALSIM format. MWH staff then fine-tuned and critiqued the model, extended the hydrology and returned the model to DWR for eventual inclusion into the statewide CALSIM II Model to facilitate the analysis of water transfers to EWA and DWR's dry year program.

d. MWH is currently using CALSIM II for various CALFED storage project analyses (i.e., Shasta Enlargement, Upper San Joaquin enlargement, Los Vaqueros Enlargement) and San Luis water quality studies.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. In the past he used the HEC-5 model of the Yuba Basin with DWRSIM and he expects to be using CALSIM Yuba model with CALSIM II.

b. He expects to use CALSIM II to look at long-term water transfers, in addition to single-year transfers.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can

include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. The impression is that the water community in California has not yet fully accepted CALSIM II as a valid model. This lack of wide acceptance leads to uncertainty in the utilizing the results.

b. Specifically, at the time of review, CALSIM II did not accurately represent Yuba Basin serial reservoir operations.

c. In various forums questions have been raised regarding the validity of how the model simulates SWP operations.

d. Biological elements drive Delta operations. There are specific time windows of opportunities for water transfers; the closer CALSIM II simulates Delta operations, the more useful the model would be for his purposes. It is unproven that CALSIM II can reasonably represent Delta operations.

e. There is a lack of CALSIM II documentation. It requires extensive effort just to learn the basics of the model.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. It would be helpful if were an official, benchmark study that everyone can use posted on DWR's website. Currently such a study is a "moving target."

b. It would be helpful if there were a "help desk" where users can go for information regarding the model. This includes help on current coding, WRESL language, node connectivity and assumptions regarding operating rules.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. He would go back to either DWRSIM or PROSIM.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. The sooner that CALSIM II gains acceptance in the water community, the sooner we can use it with confidence.

CALSIM II Interview Summary

INTERVIEWEE: Bruce Herbold
AFFILIATION: EPA
DATE: July 11, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Helped develop EPA water quality standards for the Bay-Delta in DWRSIM. Became very familiar with DWRSIM shortcomings related to the way the Bay-Delta standards were represented.

b. Does not use CALSIM II results directly, but sees them through other applications, e.g., gaming exercises for EWA and uses CALSIM II output as input to DSM2.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Evaluation of CALFED proposed projects.

b. Uses CALSIM II output in DSM2 and the Particle Tracking Model to create bookend values for Bay-Delta inflows resulting from upstream operations and exports.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Will possibly use CALSIM II to analyze water quality standards in the Bay-Delta.

b. Expect to use CALSIM II results in the "signatures" add-on to DSM2, which is currently being developed at DWR. The "signatures" add-on will compute the percentage flow from each water source at several locations in the Delta.

c. The main future use that EPA hopes CALFED will address is the impacts of global warming. CALSIM II seems the most likely tool.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration,

software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. The feedback loops between environmental conditions in the Delta and upstream operations are unsatisfactory. These feedback loops should be automatic and not require multiple manual model iterations to ensure that environmental standards are met.

b. CALSIM II does a very good job at representing reservoir operations and Delta exports.

c. A shorter time step is needed. George Barnes promised a shorter time step prior to the development of CALSIM II. Many environmental standards are on a scale of days and monthly average conditions are inadequate Also, there is a tendency for the longer time step to overestimate deliveries-- i.e. in a historical month, like February 1983, when the first half was dry and the last half was very wet then the average monthly flows would allow a higher level of export than would actually be possible under a daily operation.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Automatic feed back loops between environmental standards and upstream operations.

b. A shorter time step.

6) If CALSIM II were unavailable for your purposes, what would you use?

c. DWRSIM.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) *Who else should we talk with about CALSIM II?*

9) Is there anything else you would like to add regarding CALSIM II?

a. No.

CALSIM II Interview Summary

INTERVIEWEE: Derek Hilts (DH)
AFFILIATION: U.S. Fish and Wildlife Service (USFWS)
DATE: June 13, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Joined USBR's Planning Division in 1989 as the Engineer-in-Charge of CVP/SWP modeling. At that time, a consultant delivered the initial version of the PROjects Simulation Model (PROSIM). Made hundreds of model improvements and conducted numerous studies with the model over his 7-1/2 year tenure with USBR.

b. Made numerous improvements to the SAN Joaquin Area Simulation Model (SANJASM), once it was delivered to USBR.

c. Reviewed major portions of the Central Valley Groundwater Surface water Model (CVGSM) as well as reviewed and guided development of the SAN Joaquin Tulare Conjunctive use Model (SANTUCM).

d. Has attended CALSIM II training sessions, has made CALSIM II runs and has used the CALSIM GUI numerous times to review simulation results. Was initially excluded from the CALSIM I development, but has recently been involved in logic and data refinements for CALSIM II.

e. Has developed and applied the water module (ECOSIM-W) of the Fish and Wildlife Service's Ecologically Cogent Operations Suite of Integrated Models. ECOSIM-W simulates the CVP/SWP system on a monthly time step like CALSIM II.

f. Uses and reviews USBR's Operations Forecast (spreadsheet) model for seasonal planning of operation modifications for fishery protection and restoration purposes.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Review of CALSIM II simulated operations for long-term impact analyses of alternative operating regimes and proposed projects on storage, flows, and deliveries, usually under the auspices of NEPA or ESA documents.

b. Anticipates using CALSIM II to study the long term average impacts of various water management strategies using (b)(2), b(3), EWA, etc.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. No.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II provides a good level of detail (spatial resolution) in its representation of the Central Valley system for CVP/SWP impact analyses.

b. On one hand, it is efficient to have USBR and DWR working on a single model – pooling their resources. On the other hand, the checks and balances of using competing models is lost.

c. Because of the considerable investment in CALSIM II, it will continue to be used, even if other models are better suited to a particular task.

d. CALSIM II's six hour run time is a major detraction, especially in comparison to the few minutes that it takes to run other models (e.g., PROSIM, DWRSIM, etc.).

e. Concerned that the outflow/salinity relationship in the ANN is being trained on modeled data (DSM2). Implementation of the ANN has periodically resulted in gross and unexpected Delta outflow requirements that are then capped rather than fundamentally fixed due to the inherent nature of ANNs.

f. Unable to see the benefit of an optimization approach to simulate the highly constrained CVP/SWP system. Believes specifying rules in the model as rules rather than constraints may make results easier to explain to managers. Believes using the optimization route, with its weights and penalties approach, increases the numerical overhead and may obfuscate the interplay of competing objectives.

g. The major efforts to document CALSIM II and provide training courses are strengths. It is a very good idea to broaden the user base.

h. As with most other large models, there are a few "insiders" who understand the intimate details of the model and many "outsiders" who never will and don't want to. If there are more CALSIM II insiders than there were for DWRSIM and PROSIM, that would be a strength.

i. Another strength is that the model is beginning to stabilize, i.e., model evolution is slowing down.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Not a CALSIM II activity, but a CALSIM (the semi-generic model) activity, yes. A weekly or bi-weekly model for a one-year time horizon would be very helpful for seasonal operations planning and evaluation including (b)(2) and EWA.

b. It would be good to determine if the gross accretions for the Sacramento Valley are "in the right ballpark." DWR is currently working on this. It is as close to validation as one can get with this kind of model.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. ECOSIM. It is an improved and expanded version of PROSIM that takes less than one minute to run and has all the spatial resolution necessary to answer pertinent questions.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) *Is there anything else you would like to add regarding CALSIM II?*

No.

CALSIM II Interview Summary

INTERVIEWEE: Ken Kirby
AFFILIATION: SKS Water Management
DATE: May 30, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. He has been involved with CALSIM II since its early developmental stage, which included discussions with DWR regarding software and implementation details.
b. He and staff are generally involved with CALSIM II from a strategic, interpretation level. They also help communicate CALSIM II and model results to a broad range of people.
c. Experience working with almost every major model used by DWR, USBR and CALFED as an interpreter of results (for programs such as CALFED Water Management Program and DWR's ISI studies, in terms of surface water, groundwater, economics, and hydrology).
d. He was also involved with the development of CALVIN (at the University of California - Davis).

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. He is in primarily a support role for CALFED (eg., ISI) and DWR by helping to design strategies and inputs for CALSIM II (e.g., evaluating storage and conveyance options for CALFED).
b. Uses CALSIM II outputs as inputs for other models that look at the effects of changes on water quality, water supply, and economics.
c. Has used DWR's SWP reliability (forecast) report with CALSIM II to help other SWP contractor clients with long term planning.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Probably more activities similar to those in 2).
b. Desire to integrate CALSIM II more fully with other models (e.g. water quality, water supply, economics).
c. Modeling water transfers across the Delta.
d. Modeling the effects of changes in Delta diversions on fish populations for the purposes of EWA implementation.
e. Use CALSIM II for predictive supply reliability studies for the California Water Bulletin 160 process and State Water Contractors.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can

include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II is "totally data driven." It is "theoretically transparent and indiscernible at the same time." The model's greatest strength is also its greatest weakness.
b. The conceptual model is often not well documented or commonly understood (e.g., land use changes affect the hydrology; assumptions behind the representation of the EWA, etc.).
c. The data management structure, software, and administration is seriously prone to user error. There is almost no automated quality control in data entry and files.
d. There are no specific criteria to define a "good" model run. Currently only a small group of individuals "expert users" can decide if a model run is "good." This group is sometimes perceived to not be open to outside interaction and can raise the notion that they [DWR and USBR] are hiding something.
e. The hydrology in CALSIM II is inconsistent across regions. Some hydrology is land-use based, while some is not.
f. Representations of demands in CALSIM II are not intuitive. They are very complex and not well documented. Demands arise from some complicated and unspecified process. For example, to most people interested in exploring changing conditions, it is not clear how to change demands. Changing contract amounts do not seem to change demands.
g. It is difficult to make CALSIM II inputs tangible and communicable to stakeholders.
h. There appears to be a culture where some inputs are so accepted that they are no longer scrutinized or even understood by some of the current CALSIM II modelers.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. An improved input data environment (i.e., create a relational database and software environment for managing and documenting data).
b. Continue efforts to illustrate linkages between geographic/physical and institutional boundaries in a visual form. Use a GIS coverage map to show how the model translates the district boundaries into aggregated demand areas. It might help to give stakeholders more confidence in their area's coverage in CALSIM II.
c. Better documentation is needed. Create help documents to raise awareness of assumptions in the conceptual models.
d. DWR and USBR would benefit from expanding (or broadening) the knowledge base. Stakeholders need someone they trust to run the model. This could be accomplished through training, better documentation, and hands-on experience.
    - The CALSIM interface class is of limited use. It is a necessary, but not sufficient condition to being able to use CALSIM II.

- An apprenticeship-type program is needed if the criteria for what makes a good study cannot be written down. Or a standing review group that supports and certifies studies done by others could be helpful.

e. Software to compare changes in CALSIM II input is needed to reduce the burden on the few individuals of the "inside."

6) If CALSIM II were unavailable for your purposes, what would you use?

a. DWRSIM, PROSIM, SANJASM.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) *Who else should we talk with about CALSIM II?*

9) Is there anything else you would like to add regarding CALSIM II?

a. He is "fairly critical" of where modeling is today, but recognizes it is an improvement over where things were in the past. The demand for the use of models related to policy debates is growing faster than the modelers can respond, but he does think that DWR and Reclamation are being progressive and proactive to address these concerns.

CALSIM II Interview Summary

INTERVIEWEES: Buzz Link, Bill Smith, and Allison Dvorak
AFFILIATION: Surface Water Resources, Inc.
DATE: June 6, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

b. Buzz Link: User of PROSIM, DWRSIM, and CALSIM II. Mostly model results interpretation and developer in a minor role.

c. Allison Dvorak: User of PROSIM, DWRSIM, and CALSIM II. Minor model development.

d. Bill Smith: User of all three models. In the past involved with the development of DWRSIM for 10 years.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Uses CALSIM II for analyses of various types including water supply and flow pattern, project deliveries, environmental flows. Some current applications include EWA, environmental documents, American River revised flow standards, Los Vaqueros enlargement, WAPA marketing plan, Trinity River litigation, Oroville FERC re-licensing, Yuba County Water Authority operations. All these applications interact with other tools, e.g., temperature and salmon mortality models, DSM2, hydropower models, and local operations models.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. CALSIM II will be used for almost everything. That is the direction from DWR and USBR.

b. Likely to implement the Los Vaqueros operations in CALSIM II.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. One of the greatest strengths of CALSIM II is its single hydrology. But it would be good to know how it was done.

b. The WRESL code and solver are very powerful. CALSIM II has the flexibility to represent a wide range of operating rules.

c. There is very little documentation on the model itself and on inputs and outputs. Delta surplus outflow is not what is reported as Delta surplus outflow in DSS output.

d. The "pathname" scheme for data stored in DSS files does not identify the simulation the results came from. It is also hard to pull out all DSS data for a specific node/location in the model as more than one specification can be made on a single DSS pathname part.

e. CALSIM II uses an LP solver, but it is structured with a FORTRAN mentality. The full LP capabilities are not being utilized.

f. There are problems representing project operations to reflect real-time operations. This is a very common operator-modeler problem. For this reason, it is hard to calibrate a planning model. This is not a problem that is unique to CALSIM II.

g. We are forced to use CALSIM II for purposes for which it was not designed, i.e., in predictive mode. The uses we are asked for blur the difference between an operations and a planning model.

h. Models are tricky to modify, with so many input files scattered all over the place. It makes version control difficult.

i. The XA LP solver is expensive.

j. It is harder to figure out what is happening in CALSIM II than in PROSIM or DWRSIM. It is difficult to debug CALSIM II. Error messages from CALSIM II and the XA solver are not useful.

k. The XA solver license prevents parallel runs without purchasing additional licenses, as dongels are required to run the model.

l. XA prevents using a computer for other things while model is running; so dedicated computers for solving the model tend to be used.

m. There is very little user guidance.

n. Run time is very long, about three hours on a fast computer. This makes tweaking a model and iterative improvements very difficult and time-consuming. Fall back on using PROSIM when such iterative methods are required. The long run time prevents the use of CALSIM II as a screening tool.

o. It is hard to keep track with revisions of the Benchmark Study. Frequent release of Benchmark studies interferes with ongoing analyses.

p. Release of CALSIM II might have been premature, given the number and frequency of revisions and updates that have occurred.

q. Support for PROSIM and DWRSIM should have continued until most problems with CALSIM II had been fixed.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Would like to see CALSIM II fully incorporate water temperature and hydropower objectives. The implementation of feed-back loops for temperature and hydropower would greatly reduce the need for iterations of CALSIM II.

b. Inputs and outputs should be better organized so that it makes sense to the model user. CALSIM II should not have two things on one DSS label as this prevents efficient searching of the database. Labels in the schematic should be fixed. Model developers should not expect that model users know that Delta surplus outflow does not mean Delta surplus outflow.

c. Model documentation needs to be improved.

d. LP capabilities should be used. Several operating goals could use multi-period optimization (e.g., B2, EWA, and temperature).

e. A more sophisticated debugger is needed.

f. Run time needs to be reduced.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. PROSIM and DWRSIM for project-wide issues.

7) *For your organization, who inside or outside your organization: (name and affiliation)*

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. CALSIM II could have been a lot more than it is today. CALSIM II would have been a better product if developers had been focused on what needed to be done rather than replicating DWRSIM.

b. PROSIM and DWRSIM were dropped too quickly, long before CALSIM II was ready for release. This is still a problem for some uses and projects.

c. With PROSIM and DWRSIM we knew the model limitations. Because CALSIM II is so new, we are not sure what its limitations are. There is much uncertainty regarding CALSIM II. It will take time for the community to feel comfortable and gain confidence in the model.

d. Despite CALSIM II problems, we are positive on the tool. CALSIM II better represents many aspects of the system. The move to CALSIM II was necessary, but the model is not there yet.

CALSIM II Interview Summary

INTERVIEWEES: Joan Maher (JM) and Cindy Kao (CK)
AFFILIATION: Santa Clara Valley Water District (SCVWD)
DATE: June 9, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. No one at SCVWD currently runs CALSIM II, but they hope to in the future.

b. SCVWD uses CALSIM II output provided by DWR, USBR, or consultants (SWRI, CH2M-Hill) as input for their own models and analyses.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. SCVWD uses output from CALSIM II for long-term planning. This includes their Integrated Water Resources Plan and related models used to assess the mix of supply options available to the district (e.g., recycled water, conservation, transfers). SCVWD obtains roughly half of its supply from imports, and is a contractor with both SWP and CVP.

b. SCVWD is interested in the accuracy of CALSIM II's depiction of the expansion of Los Vaqueros, especially its representation of water quality and benefits. SCVWD would like to compare CALSIM II results against its own estimates.

c. To invest in groundwater banking in the San Joaquin Valley, SCVWD must know how much water it will have available to bank in any given year. The district uses CALSIM II output as input to their local long-term planning model, SYSMOD, for this purpose.

d. SCVWD uses Extend, a statistical model with an annual time step, to generate hydrology sequences to look at the frequency of shortages and surpluses in planning groundwater banking and other activities.

e. SCVWD needs to be able to predict the decisions that determine operation of the groundwater banks (i.e., CVP and SWP allocations). By banking groundwater, SCVWD is buying an exchange right, and so it is important to be able to predict what they are buying.

f. SCVWD also uses output from CALSIM II for annual operations planning, including predicting the annual low point in San Luis Reservoir. The district's pumping from San Luis is the first to go offline if storage falls too low.

g. In the past, SCVWD has received differing estimates of the low point from DWR and USBR. They hope to receive more consistent projections now that both agencies are using the same model.

h. SCVWD loses significant system efficiency because it is unable to predict joint operations of the CVP and SWP and their effects on deliveries to the district.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. JM looks forward to the time when CALSIM II is refined to a level of accuracy and flexibility so that it can be used to understand operational risks associated with increasing combined CVP/SWP exports.

b. Current operations (for the many parties involved) are conservative and do not maximize efficiency and use of the system. It is possible to export more than the projects currently do, but doing so would increase risk to individual deliveries. It is important to understand these risks to move forward.

c. Operating more aggressively would make it very important to understand variations in demand (e.g., high demand in late summer and early fall and their implications if storage in San Luis is low).

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. As with any model of this type, project operators do things that cannot be modeled.

b. Connections between CALSIM II and groundwater banking (specifically Kern County) are weak and will not be able to capture changes in future demands that result from banking activities.

c. SCVWD post-processes CALSIM II results to reflect how they think USBR will operate and how they anticipate SWP will handle M&I vs. agricultural allocations during the year.

d. JM wants to believe that operators can get more water out of the projects than CALSIM II predicts. In wet years, SCVWD may round CALSIM II results up for their own planning purposes, since CALSIM II rounds allocations to the nearest 5 percent. In dry years, they round down to reflect conservation during droughts.

e. CK wonders how accurate CALSIM II is in predictive mode. SCVWD uses CALSIM II output predictively, since there is no alternative source of

information on which to base their plans. These predictive analyses are ultimately important for issues such as banking agreements and transfers.

f. When they see CALSIM II results that are "way off", it is impossible to know if the error is in the model or in the way it was run (this was true for DWRSIM output in the past as well). As a result, SCVWD plans to develop in-house ability to run CALSIM II in the future.

g. It is important to keep improving CALSIM II. Everyone recognizes the tools will never be perfect, but hopes for improvements.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Training courses seem to be spaced far apart and based on demand. Good training opportunities would be helpful.

b. More online documentation of what CALSIM II can and cannot do and how its components relate to each other (e.g., representation of D1641, VAMP, etc.). What can CALSIM II do well? What can it not do well?

c. Few people are competent to use CALSIM II, which is "almost dangerous" given the number of people who rely on the model. It is important to make knowledge of CALSIM II as widespread as possible.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. DWRSIM, or the other older models (PROSIM, SANJASM, etc.)

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. SCVWD would like to see enough investment in both CALSIM II and related expertise so that users like the district can rely on it.

b. They would like to better understand what CALSIM II can and cannot do in order to determine the extent to which they should rely on its results.

CALSIM II Interview Summary

INTERVIEWEE: Harold Meyer (HM) & Jeff Meyer (JM)
AFFILIATION: Hydrologics
DATE: June 13, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Both have used USBR's PROSIM, DWR's DWRSIM and Hydrologics OASIS model.

b. HM was also involved in the development of PROSIM and OASIS.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Do not use CALSIM II except when they are working for State or Federal contractors or doing work for DWR. They use OASIS for everything else, often linking OASIS with other models.

b. Current work using OASIS includes:
   - Modeling the Middle Fork of the American River for Placer County Water Agency (PCWA). USBR asked that they implement the OASIS representation of Placer County into the CALSIM II logic.
   - Modeling of the South Fork of the American River.
   - Development of screening modeling representing the CVP/SWP based on the assumptions contained in DWRSIM for MWD.

c. Use CALSIM II outputs for boundary conditions for local models (ex. PCWA).

d. Hydrologics does a lot of modeling work outside of California using OASIS. Examples where they have done modeling work include:
   - Delaware (for the Delaware River)
   - South Florida Water Management District (SFWMD)
   - Kansas
   - New York

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Only use CALSIM II when working with the State or Federal agencies. Some future work includes:

- COA (Coordinated Operations Agreement) Review
- OCAP (CVP Operations Criteria and Plan) Review

b. May use CALSIM II as a source of information for use in the development of more detailed local models or for models of basins upstream of the current modeling area.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. A strength of CALSIM II is that it is data driven so that none of the operating rules or data is within the source code.

b. CALSIM II is LP based which means the model works in the same manner as an operator in terms of goals and constraints on operations.

c. CALSIM II has a "cycle" capability that enables the model to simulate either a portion of the system or the entire system under a specific set of assumptions and base subsequent "cycles" on the results of a previous "cycle".

d. The use of the FORTRAN compiler during run time is cumbersome and unnecessary.

e. The WRESL language needs to be expanded. In particular, there is too much use of the "define" statement. If the user is not extremely familiar with the "define" statement, the WRESL code can be difficult to understand.

f. It seems that CALSIM II uses a lot of the old DWRSIM logic and does not take advantage of the new software capabilities.

g. Communication between modelers and operators remains a problem. New modelers do not know the operations of the system and the old system operators do not know how to model.

h. The GUI for CALSIM II is poorly designed. Opening a "study" does not automatically load all the inputs. Instead the GUI requires that the user find, open and load each data table before the data can be viewed. In addition, almost all of the studies run with CALSIM II will be multiple study runs that cannot be handled by the GUI. Instead a Multiple Study Rapper (MSR) is used to execute the model and the only way to look at each study of the run is to open studies separately.

i. Documentation and user support is very weak. They need a "300 page" manual just for the application alone. Expansion of the description and use of the WRESL language with specific examples would be helpful.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. The GUI needs to be redesigned to accommodate the multiple study runs.

b. Better support for users outside of the agencies is needed.

c. Much better documentation is needed.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. OASIS

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

b. There are probably several things that could be done differently in CALSIM II, but these are often just individual preferences and not real weaknesses in the model.

c. Has heard that "few people used DWRSIM and fewer people are using CALSIM II." This could be a function of the additional difficulties facing California water management (EWA, (b)(2), ESA) modeling.

d. If people understood the model, it would develop credibility and trust.

e. The people who have put CALSIM II together have done a "marvelous" job dealing with the difficulties of the system.

CALSIM II Interview Summary

INTERVIEWEE: BJ Miller
AFFILIATION: Consultant
DATE: May 5, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. "General level" involvement. His work includes "figuring out" what happens to the future of California water given any changes. Assessment tools include using results from CALSIM II.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. His major client is a large agricultural district who uses CALSIM II results on a regular basis for water allocation decisions.

b. He has not used the model for two years and has not had specific need for the model during that period of time. However, he has occasional been asked to look at results from CALSIM II model runs (for example, comparing results with and without Projects).

c. He has indirectly used the CALSIM II model with particle tracking models and Delta hydrodynamic models.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. He does not anticipate having to "personally" run the model.

b. If a client wants to have some options assessed, he would then help the client determine how the analysis should be conducted. This could include a CALSIM II model run.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II uses a monthly time step. An example of the difficulty in dealing with the monthly time step is a "gaming exercise for the Environmental Water Account" where CALSIM II monthly output had to be disaggregated into daily data for both Delta and water transfer options. The daily time step is

important both for representation of Delta regulations as well as representing details of water transfer operations.

b. The geographical extend of CALSIM II is too limited to accurately analyze options available within California. Specifically CALSIM II does not include MWD's link to East San Joaquin reservoirs, the Friant-Kern and Madera canals, Millerton, and details regarding the Bay Area. Users should not have to "shoehorn" in these features/geographic aspects into the analysis. He is also concerned that the Colorado River is not included in the geographic extend of CALSIM II.

c. CALSIM II represents a very limited variety of water management options, particularly options at local and regional levels. He wonders if CALSIM II can handle the kinds of options that are becoming more common: water transfers and exchanges, water transfer options, and groundwater banking. CALSIM II should "simulate the system rather than the components of the system that used to be most important," i.e., state and federal projects).

d. Saying that the model is only useful on a "comparative basis" tends to raise suspicions.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. CALSIM II developers need to look into local and regional plans for different parts of the state (examples could include MWD, East Side San Joaquin Valley, and the Bay Area) to see what options the various water agencies are considering and to determine if CALSIM II is capable of modeling these options. If CALSIM II is unable to model these options then either an iterative post-process analysis is needed or developers need to start over and create a new model

6) If CALSIM II were unavailable for your purposes, what would you use?

a. He would call Maury Roos or Russ Brown.

b. He would create an ongoing operators forum, where operators from the state and federal projects, along with representatives from key agencies would meet to deal with questions that arose. This forum would additionally require a group of analysts that would deal with the technical details and eventually produce a model of the system.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) *Is there anything else you would like to add regarding CALSIM II?*

   a. "It would be great if someone like me could use the model." He feels that it would be useful to have a user-friendly website where he could go with confidence and find answers to some typical questions. This website would also contain the results from "typical" model runs for some of the more "common" questions.

CALSIM II Interview Summary

INTERVIEWEE: Armin Munevar
AFFILIATION: CH2M-Hill
DATE: June 16, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. While working at DWR between 1995 and 2000, participated in the development of CALSIM and CALSIM II.

b. Worked with DWRSIM for alternative evaluations.

c. Worked with spreadsheet gaming models based on CALSIM II and DSM2

d. Worked with IGSM and DSM2.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Primarily for alternative impact assessment on water supply and water quality.

b. CALSIM II is used as a front-end tool for gross water supply analyses. More detailed analysis of impact to fisheries and water quality is performed with more detailed models such as DSM2.

c. CALSIM II output is used as input to DSM2, temperature and salmon mortality models, and gaming models.

d. CALSIM II is generally used for comparative analysis rather than for absolute values.

e. Currently running a simplified version of CALSIM II to screen water transfer options in the Sacramento Valley. This may be coupled with the full CALSIM II for analysis refinements.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Primary use will continue to be for impact analysis on water supply and water quality, and for input to gaming exercises.

b. CALSIM II results may form the base for evaluation of water transfers.

c. Likely to link CALSIM II with regional groundwater models to better evaluate surface and groundwater interactions.

d. To explain what is driving water transfers, CALSIM II may be linked, in the uture, to agricultural economic models (e.g., CVPM). Currently, CALSIM II and economic models are run iteratively, as CALSIM II is driven by static land use projections. Model linkage (perhaps on an annual basis) could allow for land use to respond dynamic to economic factors.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II should be used in comparative mode. There is a lack of documentation that explains what type of model CALSIM II is, what it can do, and how it should be used. If CALSIM II is to be used for absolute values, then likely errors bounds should be included.

b. One of the greatest strengths of CALSIM II is its flexibility. It is relatively simple to incorporate new rules, particularly when compared to its predecessors.

c. The greater detail in the hydrology is a great improvement over previous models.

d. The flow-salinity relationships in CALSIM II are an improvement over previous efforts. However, the ANN is still weak in its ability to capture the full hydrodynamics of DSM2.

e. The weight structure is a limitation on the ease of use of CALSIM II. Because of the complex nature of the system modeled by CALSIM II, weights interact in ways that are very complex for the casual user. Assignment of weights can be very difficult and time consuming.

f. The (b)(2) and EWA simulations are an improvement but still have some way to go.

g. The lack of explicit definition of risk is a weakness of CALSIM II. The level of risk for each CALSIM II simulation is user dependent. A more structured approach to allocation reflecting real-time operations is needed to "tighten" the system simulation.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. See 4a. Documentation of the model is "paramount" and goes a long way toward building trust in CALSIM II results.

b. A weight pre-processor such as the one used in MODSIM where priorities are specified and the pre-processor generates weights.

c. Allocation procedure needs further work (see 4g.).

d. A GUI relating the schematic to the system connectivity would be very useful. The text based connectivity table should be eliminated.

e. Multi-period optimization capability with different drivers would be useful, especially for defining new allocation rules.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. If CALSIM II were unavailable, would have to use DWRSIM or PROSIM, depending on the application. However, would not be too comfortable using either model, as significant enhancements that have been made in CALSIM II are not available in either PROSIM or DWRSIM.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) *Is there anything else you would like to add regarding CALSIM II?*

a. Much of the concern over CALSIM II arises from a lack of documentation of its limitations. CALSIM II is a rule based model, and not a physically based model. Educating those who don't use CALSIM II regularly would help bring people to a common understanding. Most of the real-time operations nuances are not in CALSIM II. CALSIM II is a monthly model and operators tend to be more conservative than CALSIM II simulations. Therefore, it is not realistic to expect CALSIM II to reproduce historical operations. A greater effort must be made to ensure that CALSIM II users are aware of its limitations.

CALSIM II Interview Summary

INTERVIEWEE: Dennis O'Connor
AFFILIATION: State Senate Agriculture and Water Committee
DATE: April 30, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Responding to concerns from legislators and their constituents that model results do not match how the system works.

b. Policy decisions based on CALSIM II results, can lead to concerns regarding the validity of the CALSIM II model.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Results from CALSIM II & predecessors are used to specific projects that were suggested by DWR and others for specific project authorizations.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Determine if water supplies are sufficient to support proposed land uses.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II seems a reasonable tool to use for comparative analysis. For comparative analysis, minor problems (such as some system biases) will cancel themselves out. CALSIM II may not be so useful for specific performance questions, where absolute (cardinal) values would be used for decision making (example: SWP reliability studies).

b. CALSIM II water demands are based on historical December water contractor requests. In December, hydrologic conditions for the year are not known. In reality water users decrease requests if hydrological conditions are favorable; this is not reflected in the model. Consequently the model will predict much greater deliveries than has been historically observed, because demands in the model are often higher than they will actually be

c. "CALSIM inhales data." Many detailed assumptions are needed to characterize the system. It seems unrealistic to accurately characterize the system at that high level of detail. This is less of a problem for comparative analysis uses, but it is possible to have mischaracterized the system, which makes it "dicey for policy purposes." Data seems unavailable to calibrate the model at this level of detail.

d. CALSIM II uses a monthly time step. Without testing it is difficult to tell if a daily model would be more accurate and useful because a daily model would require even more data and assumptions to characterize the system. For planning activities, a daily model seems unnecessary.

e. CALSIM II assumptions are not documented in a way that policy-makers would understand. The detailed assumptions are documented at a very technical level, without any explanation of how that relates to high-level assumptions. This creates a high potential for miscommunication between the policy maker and the technical staff.

f. CALSIM II studies take considerable time to prepare and execute. Policy questions arise fairly rapidly, often with many iterations, this requires fairly rapid turn around times. As a result many decisions are made without CALSIM II (or any analytical reasoning).

g. Can the model and model results be presented in a way which is more intuitively understandable? Perhaps tied to a GIS?

h. As a consequence of the complexity of CALSIM II, the model's assumptions are not well documented. Perhaps the model is too big to be well documented.

i. CALSIM II represents a "clearly non-linear" system using a linear model formulation. This is a source of discomfort, although he realizes the computational difficulties of non-linear models.

j. Global climate change is an important issue and needs to be studied. However, when asked, DWR asserts that they have "no idea how to create the hydrology" and cannot use synthetic hydrology to model the future. The Scripps people pointed out that given climate change "the past is not an accurate predictor of the future", but CALSIM II implicitly assumes that the past is a good predictor of the future.

k. Has heard that CALSIM II represents groundwater basins as essentially having no physical limits (i.e., it can pump basins dry and then re-fill without any consequences). If this is true, it could create biases that would also affect comparative results.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Policy makers need to have confidence in the model. Without a critical self-evaluation of CALSIM II by model developers, it is difficult for policy makers to feel confident in the model results. There needs to be documentation, where the limitations of the model are clearly stated and the possible consequences of those limitations are also identified. The self-evaluation is a "necessary, but not sufficient condition" to give policy makers more confidence in the model.

b. Additionally, outside evaluation needs to be conducted (akin to an external audit report). Need a fine level review, much like an anonymous journal review. It needs to be conducted by qualified, interested people who do not have any "vested, self-interest" in the model. There should be two levels of review:

    1. Is it capable of answering the questions that are asked?

    2. Is it calibrated and used in a way that is reasonable?

c. CALSIM II needs implementation protocols and periodic testing procedures to increase credibility among policy makers. It needs a "Good Housekeeping Seal of Approval" signed by the "right" people and dated. The implementation protocols need to include a list of uses for which CALSIM II is appropriate and a list of uses for which it should not be used.

d. There is an overall communication problem with DWR support staff. The department does not answer the questions and concerns raised, but rather answers the questions and concerns for which they already have answers.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. For the kinds of questions that I (Dennis O'Connor) am asked, a linked spreadsheet with an assumptions page would suffice.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. People who rely on CALSIM II the most might not even know it exists. There is a lack people who understand both modeling and policy.

b. For any model, the questions to be asked need to determined first and the tools to use, second.

CALSIM II Interview Summary

INTERVIEWEES: Leah Orlof (LO) and Jeff Quimby (JQ)
AFFILIATION: Contra Costa Water District (CCWD)
DATE: May 13, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Leah Orlof has reviewed output from CALSIM II and is also involved in efforts to refine the ANN and improve the representation of salinity in CALSIM II.

b. Jeff Quimby helps develop CCWD's input for CALSIM II using CCWD's in-house operations model. He also reviews output from CALSIM II.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. CCWD's primary use for CALSIM II is to evaluate the effects of various Bay-Delta projects on CCWD and its Delta intakes, including effects on water quality and water supply.

b. CCWD uses CALSIM output as input to the Fischer Delta model (water quality), the G-Model (salinity-outflow), and other models related to Los Vaqueros Reservoir operations.

c. CCWD wants to ensure that CALSIM II provides a realistic forecast of results of Bay-Delta actions.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. LO would like to develop the ability to run CALSIM II in-house as needed (e.g., to develop response plans regarding water quality at CCWD's Delta intakes), and to integrate the in-house use of CALSIM II and the Fischer Delta Model

b. JQ would like to integrate CALSIM II with CCWDops (CCWD's in-house operations model).

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. LO believes that the salinity modeling in CALSIM II requires "careful scrutiny." Water quality standards such as salinity drive many operations, and so it is very important to validate CALSIM II's representation of these characteristics.

b. LO states that carriage water estimates are important and therefore in need of validation.

c. JQ believes that CALSIM II should characterize CCWD's supply more subtly than in the current model, using two arcs to show connections to both Los Vaqueros and CVP water, rather than the current single arc.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Both LO and JQ would appreciate the creation of a CALSIM II users' group to bring experts and new users of CALSIM II together, possibly through a monthly meeting, to facilitate education regarding the model.

b. LO would like to see the continuation and completion of ongoing efforts to develop historical comparisons to establish a foundation for CALSIM II.

c. LO would like to see the continuation and completion of the CART process to evaluate and improve salinity modeling.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. DWRSIM.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

No.

CALSIM II Interview Summary

INTERVIEWEES: Duane Paul
AFFILIATION: Northwest Economic Associates (NEA)
DATE: May 21, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. His involvement with CALSIM II has been "tangential at best".

b. Most of the work done at NEA uses economic models such as CVPM or CALAG. We use results of water resources model done by others as input to economic models.

c. The CALSIM II model defines the overall system, but he has no expertise on CALSIM II model details.

d. Output from other models used as input to economic models is assumed to be correct.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Agriculture is one of the primary areas for NEA's projects. Among other issues, effects of policy actions on irrigation districts are evaluated.

b. His most recent interest in CALSIM II results from his involvement in the Bulletin 160-03 process.

c. He attempts to understand the linkage between CALSIM II and CALAG, CVPM or other agricultural models.

d. He is interested in the overall integration of all models used in the California Water Plan Update. It is important to identify uses and needs of all models. He is not certain how CALSIM II and CALAG can be integrated, and is frustrated that CALAG is not in the public domain.

e. In the PEIS process, many modeling iterations were performed before the regional economic analysis could be completed (e.g., CVPM and PROSIM iterations).

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. He does not know. It would depend on whether or not NEA staff would be able to use CALSIM II without extensive water resources system modeling training.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. He knows very little about CALSIM II details.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. To use CALSIM II, it would be necessary to study the model documentation to determine the expertise required to run the model. It would be good to have available a short (four to five page) document that describes what the model does, how to run it, etc.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Would rely on engineering consultants to develop another model.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

DWR is far ahead of other states in the development of analysis tool. He has great respect for DWR modeling efforts.

CALSIM II Interview Summary

INTERVIEWEES: David Purkey (DP) and Brian Joyce (BJ)
AFFILIATION: Natural Heritage Institute (NHI)
DATE: June 5, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Brian Joyce has spent the past nine months working with the "guts" of CALSIM II. He has helped to develop new logic for North of Delta offstream storage and a conjunctive use/groundwater banking module, and has written the WRESL code needed to incorporate these changes into CALSIM II.

b. David Purkey works on developing logic for new CALSIM II runs to examine the effects of North of Delta offstream storage and groundwater banking, but he does not write code or run the model.

c. David Purkey and the Natural Heritage Institute have developed models in the past, including using the Stockholm Environment Institute's Water Evaluation and Planning System (WEAP) to model reservoir storage and groundwater banking in the Central Valley. NHI is currently using WEAP to evaluate the effects of climate change on the Sacramento Valley.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Currently, NHI is not using CALSIM II with any other models.

b. Eventually another contractor (RMA) will add a water quality component to NHI's North of Delta storage study. NHI will use a daily disaggregation algorithm provided by DWR to prepare output from its CALSIM II runs for input to the water quality model, which will consider temperature and dissolved oxygen, among other parameters.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. NHI would like to continue to develop better logic to represent groundwater banking in CALSIM II, expanding beyond their current North of Delta storage study to broader representation of groundwater in CALSIM II.

b. DP would like to use CALSIM II to examine the value of groundwater banking and to compare CALSIM II results with those from an earlier spreadsheet model that he created.

c. DP would like to develop logic for CALSIM II so that it can be used to generate yield estimates. He has used spreadsheets to model this before and would like to compare the existing results with yield estimates generated using CALSIM II.

d. DP would like to be able to use CALSIM II to study options for fluvial process restoration. This would require a daily (or shorter) time step or disaggregation of monthly results.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II's greatest strength is that it represents the entire Central Valley system. "Finally everything is in one package."

b. CALSIM II is a general model, but it is easy to customize and move components, including new additions, around the geographic system.

c. The current setup of CALSIM II is very intimidating in terms of understanding how CVP and SWP operations are represented within the model.

d. The thousands of links between input fields in CALSIM II's data structure make it difficult to understand. BJ is not sure if a database structure for the model would be an improvement.

e. Better documentation throughout the model would help people learn and understand it more easily. Specifically, little information is provided regarding the meaning of individual cycles and studies and the reasoning behind their placement in the sequence of the model's execution.

f. There is no defined metric against which to compare CALSIM II results. Even given the benchmark study, there is no standard for which specific parameters should be considered when comparing the results of two studies.

g. Indicators for the performance of the benchmark are neither transparent nor transferable.

h. DP and BJ have encountered many built-in assumptions (e.g., 25 percent yield for groundwater storage) for which there are no explanations or sources. There is no documentation of the basis for these assumptions, but they can have a profound impact on results.

i. There seem to be many assumptions built into the WRESL code. Including these rules in the benchmark study will make it difficult to make comparisons with some model runs for which these assumptions must be relaxed (e.g.,

adjusting the delivery-carryover curve as a part of reservoir re-operation in coordination with conjunctive use management).

j. People are too committed to the details and assumptions used in the benchmark study, even in the face of legitimate questions. They feel that if you change the existing assumptions, then you can no longer use it for comparison. This makes innovation difficult, particularly regarding integration of newer facilities involving modifying existing operating rules.

k. CALSIM II represents groundwater as a "bucket" that does not respond as an aquifer would. It is a fair representation for a systems model, but it could be improved.

l. LP solver error messages provide inadequate guidance regarding where infeasibilities occur or other sources of the error. One has to reconstruct the model piece-by-piece to debug it.

m. There is no individual assigned to provide support to users of CALSIM II. When questions are sent to knowledgeable individuals, they often go unanswered. This issue is of particular importance to non-agency, non-consultant groups such as NHI who are not affiliated with existing sources of knowledge and support for the model.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Better documentation of the general background of CVP and SWP operations and how they are represented in CALSIM II would be helpful to those learning the model.

b. A graphical interface showing all nodes in the most current version of CALSIM II would be useful, since most physical schematics are out-of-date with changes to the model.

c. A user board to which to post questions would be useful.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. DP would use a spreadsheet model of the CVP, which looks at each reservoir and groundwater bank as a pair, and is not a system model.

b. DP might use WEAP to build a new model, he might use CALVIN, or he would create a new, large spreadsheet model.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

CALSIM II is and advancement over its predecessors and does a reasonable job.

a. The real power of CALSIM II will be realized when the user community broadens beyond the agencies and consulting firms and when other groups can use it independently.

CALSIM II Interview Summary

INTERVIEWEES: Spreck Rosekrans
AFFILIATION: Environmental Defense Fund
DATE: May 29, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. In 1989-1990 was asked to look at state water planning models to identify what it would take to meet environmental requirements in the Delta. EDF was, perhaps, the first non-DWR group to get a copy of DWRSIM.

b. Testified in SWRCB D-1641 hearing that there was a serious problem with the way DWRSIM simulated CVP deliveries without a rule curve, and demonstrated that using a rule curve would reduce the costs of implementing environmental standards in the Delta by approximately 35%. Rule curves were later implemented in DWRSIM.

c. Work with models of California's water resources has been mostly limited to scrutinizing modeling results of proposed projects and environmental standards. Interest focused on whether or not the model adequately represents what could happen. Although models are not exactly accurate, they do provide useful results.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Mostly to look at systems operations and performance due to alternative regulations, additional environmental objectives, and proposed facilities.

b. Always uses Excel spreadsheets to analyze CALSIM II results.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Currently interested in using CALSIM II to look at O'Shaunassy Dam removal and resulting systems re-operations. Might add some groundwater representation (or model) for this application and alternative delivery objectives. Alternatively, might use the Hetch Hetchy spreadsheet model to obtain inflows to Don Pedro for CALSIM II.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration,

software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II's learning curve is too steep. Cannot run the model despite having taken the training class. Used to run DWRSIM, but CALSIM II is too hard to modify and run. Does not know where to begin to modify capacities, rule curves, etc. CALSIM II was designed to be easier to use. However, it is now much more complex and harder to use than its predecessors.

b. Agrees with George Barnes that model is best used in comparative model. Not confident in its use for absolute predictions.

c. Obtaining input and output is easier and more straightforward with the DSS database.

d. I would be useful if CALSIM II computed water balance at different nodes both for debugging and display of results. This was a nice feature of PROSIM.

e. For predictive uses, CASIM II deliveries should be de-rated, based on comparisons with historical performance.

f. Because of the monthly time step, CALSIM II is over-optimistic for export capabilities. Large Delta inflows that occur for part of the month are averaged out for the entire month. This results in an apparent ability to run export pumps at the limit for the entire month, which is not realistic.

g. CALSIM II lacks groundwater adequate representation, both in terms of modeling and data.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Better model documentation, including hyperlinks. Would like to be able to click on a node to obtain all the information about that node that is used in the model, including where data comes from and where to find original calculations used to derive it.

b. Would like CALSIM II to be easier to use so that runs can be done locally.

c. If b. is not possible, then would like to have DWR do free runs in a timely manner.

d. Would like to have CALSIM II output mass balance for every node in the schematic.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Usually reacts to others use of CALSIM II. For the Hetch Hetchy analysis, a local spreadsheet model was developed.

b. For larger problems, would probably build a spreadsheet model based on actual operations.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

No.

CALSIM II Interview Summary

INTERVIEWEE: Rich Satkowski
AFFILIATION: SWRCB
DATE: July 29, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Rich Satkowski does not work directly with CALSIM II. His involvement with the model is through Model Forum workshops and the annual meeting.

b. While at SWRCB, used DWRSIM results provided by DWR to evaluate operations in the Delta.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. The Modeling Forum does not use CALSIM II directly, although some of its members do.

b. SWRCB uses CALSIM II results (as they used DWRSIM results in the past) for licensing and permitting and for use with the Delta hydrodynamic model. DWR conducts CALSIM II runs for them.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. The next stage of the Bay-Delta hearings will use CALSIM II, as will the California Water Plan.

b. California needs a good water rights model that can evaluate supply and availability. The state currently uses models at the watershed level, which are crude. For example, Texas has set up larger models to address water rights, which would be helpful in CA.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. The biggest weakness of previous models was the input data. Model runs were completed for CEQA analyses to establish a base case representing present conditions. However, the results of these runs were inconsistent with

reality, providing a weak baseline for comparison. This is still an issue with CALSIM II.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. CALSIM II should include or somehow address water rights. A version of CALSIM II that works with or represents the California water rights system and could be used for both real time operations and planning would allow SWRCB to look at availability in different watersheds. This would be particularly valuable during droughts when SWRCB must determine who to cut off.

b. A user group for CALSIM II so that users could exchange information about, support for, and improvements to CALSIM II.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. The SWRCB would use PROSIM or DWRSIM, or a basic spreadsheet model, although this would have limited uses. Without these options, it would be planning California's water without any good tools.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

c. No

CALSIM II Interview Summary

INTERVIEWEE: Dan Sheer
AFFILIATION: Hydrologics, Inc.
DATE: June 27, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. He wrote PROSIM with Harold Meyer.
b. Emulated DWRSIM with OASIS, and offered to give OASIS to DWR with the caveat to not distribute the model outside of California.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. No use of CALSIM II at the moment.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. None in mind at the moment.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. If OASIS did not exist, CALSIM II would probably be best.
b. It is the only model capable of flexibly representing operations.
c. Implementation is difficult with respect to the WRESL language, which makes the user work harder than is needed with OASIS.
d. The need for a FORTRAN compiler is awkward. Eliminating the need for this compiler would require re-writing the model software.
e. DWR has felt compelled to simulate the system as it exists. The effort would have been much better spent trying to find better operating rules. California needs to focus more on performance for beneficial uses than on "who gets what."

f. The nature of CALSIM II development and use is thus counterproductive in improving California water management. CALSIM II development is controlled by political fears of some stakeholders.
g. Someone needs to figure out how to get someone free to look at real water management innovation.
h. The concept of CALSIM II is right and very similar to OASIS. Implementation of this concept is somewhat different between these two models.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Make CALSIM II good enough so he does not need to maintain OASIS.
b. Disappointed that CALSIM II could have been a better model if it had been developed cooperatively.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. OASIS

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. Benefits from good analytical tools are no more than the creativity of the people who use them. Creativity is limited by constraints put upon model users by institutions.

b. California invests relatively little in letting people "follow their nose" to create good alternatives, regardless of if they are currently legal.

c. Good alternatives will fly on their own. It would pay to invest in university, agency, and consulting researchers.

d. It would be a lot cheaper for California to buy and modify OASIS than to modify CALSIM II.

CALSIM II Interview Summary

INTERVIEWEE: KT Shum
AFFILIATION: East Bay Municipal Utility District (EBMUD)
DATE: May 21, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Over ten years modeling Delta hydrodynamic and water quality. Worked on the refinement of the Fischer Delta Model (FDM), and was involved in the DSM2 Development Project Work Team and CART (CALSIM ANN Refinement Team).

b. Reviewed CALSIM II results from a number of studies.

c. PI of a CALFED funded project to review and improve empirical formulations in water quality and hydrodynamic models of the Bay-Delta system.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Analyze and compare CALSIM II results on the performance of different alternatives for CEQA/NEPA and other purposes.

b. Apply output hydrology from CALSIM II to estimate water quality and hydrodynamics in the Delta under different scenarios, in particular the differences between these scenarios in meeting drinking water beneficial uses of Delta water.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Evaluate performance of CALFED actions

b. Evaluate sensitivity of the Central Valley water supply to climate change

c. Evaluate the role of individual watersheds in water management in the Central Valley and Delta system

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

Questions 4) and 5) are addressed together in the following. The issues addressed are classified into three categories – Model Framework, Model Algorithm, and Interpretation of Results.

Model Framework

1. CALSIM II is currently set up to simulate CVP and SWP performance over a 73-year historical hydrology. Whether this is the most appropriate framework, particularly in light of potential climate change, requires some reflection. For example, how would the projects perform in more extreme droughts? This issue may be more significant if CALSIM II is to be used to aid in the optimization of Project operations. Two alternatives to the use of historical hydrology are:

- Design hydrological sequences to explore the performance of the Central Valley system under stress (droughts or otherwise)
- Stochastic hydrology

2. Limitations on the range of model applications and the interpretations of model results are not clear. At this point, it is sometimes difficult to assess whether the differences in CALSIM output for two alternatives are "real" (i.e. if they are likely to occur if the "hydrological history" is to repeat under simulated operations scenario), a "possibility", or "unlikely" (i.e. differences are primarily due to model assumptions and would unlikely occur in real time operations). These limitations will be discussed below.

3. There are considerable uncertainties in ANN prediction of the flow requirements for meeting Delta water quality standards. One approach to estimate the resulting uncertainty in CALSIM II results is to maintain and support the G-Model version of CALSIM II. Having multiple versions of the model (each with a different Delta salinity relationship or different assumptions and approximations of regulatory constraints and operational priorities) would be useful in assessing uncertainties in model results.

Model Algorithm

Decision Framework

4. The use of discrete operation decision thresholds ("step functions") in model algorithm could result in changes in model output that are large in response to much smaller changes in model input. Even though many of these differences would average out over a longer time period, month by month comparisons of two alternatives could show large "impacts" that may be a modeling artifact that is unlikely to occur in real time operations.[1]

[1] One example is Delta Cross Channel gate operations. If one alternative has Sacramento flow above 25,000 cfs in December of a dry year, say, and another alternative below, CALSIM would have the gates closed all month in the first case and open for 16 days in the other. When Delta salinity is high, this could lead to large differences in Delta salinity in the two alternatives that may not occur in real time operations. Furthermore, the CALSIM II algorithm may not capture this salinity difference in subsequent months because of apparent low estimates of carriage water in ANN in many cases.

5. It is not clear how the LP solver is used in CALSIM II, and if optimization is part of the algorithm. If optimization is used, the properties of the objective function would need to be better understood. It is possible that the objective function has a "flat surface" that would render solutions in individual months subject to large changes when model inputs or model parameters are changed even slightly.

Delta Salinity

6. Water needs to meet Delta salinity standards are determined using an "ANN" algorithm. It appears that the current ANN routine in place could predict carriage water needs to be as large as 80% (i.e. Sacramento inflow would have to increase by 1.8 times that of an increase in export). Such a large carriage water estimate may lead CALSIM II to curtail exports and postpone to a time when Delta salinity is higher. It does not appear that large estimates of carriage water cost are consistent with results from numerical models such as DSM2 or FDM. At the same time, there are instances when ANN predicts much lower (close to zero, may even be negative in some earlier versions) carriage water cost than DSM2 and FDM.[2] These apparent inconsistencies could lead to large differences in DSM2 estimates of Delta salinity from CALSIM output hydrology for two very similar alternatives.
7. It is not clear if CALSIM II puts a high priority in minimizing salinity at drinking water intakes in the Delta. In the absence of an appropriate weighting for water quality considerations, CALSIM may give results with large differences in salinity at drinking water intakes for two alternatives with nearly identical performances in water supply and other measures. Whether such large differences would occur in real time operations should be addressed.

System Flexibility

8. The Central Valley water supply has shown drought management flexibility that might not be simulated in CALSIM II. In extreme droughts, alternative options to meet demands such as water transfers (with fallowing), conjunctive use, and other practices might occur to an extent not modeled. As a result of this lack of elasticity in demand management, competing needs might not be met in extreme droughts. An example is Shasta carryover storage, which is below the end-of-September objective of 1,900 TAF more often than expected in the benchmark study.

Results Presentation

9. More effort should be placed on performing sensitivity analyses of model parameters, input, and assumptions. This would allow a better understanding of CALSIM II performance. If simulation results are not close to what is expected,

[2] These observations are based on reviews of ANN output in CALSIM simulations of slightly different scenarios.

the underlying causes must be explained to allow proper interpretations on whether they would actually occur in real time operations.

10. Some indications of the magnitude of uncertainties in CALSIM II results (due to the approximations and assumptions used in the model) are necessary. Two forms of model output would appear to be more appropriate than a single value that is provided in current version of CALSIM II:

- Provide a range (rather than one single value) for each model output, with appropriate constraints. For example, Shasta storage in a certain month *m* would be given as between *a* and *b*, Oroville between *c* and *d*, …, and the total north of Delta storage in month *m* is *z*.
- A more informative presentation of results would be in terms of statistical parameters (as averages, variances, medians, and ranges). These statistical parameters could be based on results from a number of models, each using slightly different assumptions and approximations. They could also be generated using the same model with small perturbations of model input.

11. An alternative to presenting CALSIM II results "in an absolute sense" (i.e. as one single value) in the short term would be post-processing the monthly results into appropriate aggregates (e.g. as longer-term averages or as total system storage rather than individual reservoirs).

12. In comparing alternatives, month-by-month impact estimates of Delta salinity based on CALSIM II output hydrology may be unreliable. In one particular simulation of two alternatives that are very similar, CALSIM II results show a number of months in which there are large percentage changes (~O(10%)) in Delta outflow that are preceded within a couple of months by changes of comparable magnitudes in the opposite direction. In each one of these periods, the sum total of all changes in upstream releases (Delta inflows) and/or exports over the period is much smaller than the magnitude of changes in individual months. The overall effect of these changes on water supply in each period is small. However, these changes could lead to significant changes in Delta salinity over the same periods if they occur at a time when Delta salinity is already high. Such variations in the differences in Delta outflow between different alternatives could be triggered by assumptions and approximations in the algorithm used in CALSIM II, but may not occur in real time operations. It is difficult to determine whether such impacts are real or an artifact of the model. Presentation of model results as averages over a longer term appear to be more appropriate, as discussed above.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

See response to Question 4 above.

6) If CALSIM II were unavailable for your purposes, what would you use?

Potential alternatives include "spreadsheet models" and "educated guesses". However, given the large number of regulatory constraints and competing

demands on system operation, CALSIM II may be the only tool that could provide credible solutions.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

The agencies have been open to stakeholders input in the development process, for example in the CART process. A transparent and open process is probably the single most important aspect in building stakeholders' confidence in the model and modeling results.

A comparison of CALSIM II output and logic to real time operations and operators' approach would be useful in understanding the implications of CALSIM II results. Recent work in this regard (presented at CWEMF's Asilomar conferences) are helpful. More detailed comparisons, in particular CALSIM II decisions *versus* CVP and SWP operators' decision approach, would be of great interest.

CALSIM II Interview Summary

INTERVIEWEE: Jim Snow
AFFILIATION: Westlands Water District
DATE: June 12, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Worked in the operations group in DWR using spreadsheet models to determine State Water Project allocations.

b. Uses results of models to look at performance of different projects.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Looks at and reviews model results both for long-term and seasonal water contract allocations resulting for changes in existing facility operations or additions/expansions of facilities.

b. Use CALSIM II to look at impacts of projects and regulations to Westlands' water supplies. Examples include:

- Changes in required Trinity flows and the effects it would have on upstream storage and downstream deliveries.
- A physical intertie between the California Aqueduct and the Delta Mendota Canal and the effect it would have on downstream deliveries.
- Any changes in the (b)(2) operations and its long term effects on Westlands' supplies and allocations.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. CALSIM II will continued to be used for comparative analyses. Changes in project operations and regulations that will be studied are:

- (b)(2)
- Delta criteria
- Coordination with the State on the Joint-Point of Diversion.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can

include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II seems to overestimate deliveries compared to real-time operations and operations spreadsheet models some times.

b. CALSIM II is a comparative model and cannot be used in an absolute manner.

c. The range of CALSIM II results for each year-type is very broad (ex. 50%-90% of allocations in wet years) and often not consistent. The same year-type does not always produce the same flows. This often discourages use of CALSIM II.

d. DSS is difficult to use and get results out of in an easy and meaningful manner.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. If possible, CALSIM II should be calibrated for real-time and seasonal operations. CALSIM II then could replace the CVP and SWP spreadsheet models.

b. The real-time and seasonal operations model should be a different version of the model, using the same modeling framework, but be predictive (not comparative). There might be some advantage to being able to run the model for a few years at a time in a predictive manner.

c. Calibration documentation of the real-time version would be important.

d. CALSIM II output needs a better interface tool.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. PROSIM or DWRSIM and spreadsheet models for real-time operations.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. It has done an "admirable" job trying to look at adaptive management approaches (ex. (b)(2) & EWA), but it still needs improvement. However adaptive management is difficult to model and he recognizes that fact.

CALSIM II Interview Summary

INTERVIEWEE: Frances Spivy-Weber (FSW)
AFFILIATION: Mono Lake Committee
DATE: July 28, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Frances Spivy-Weber does not run CALSIM II or work directly with the model, but has used its results as part of the Bulletin 160-98 and the current Bulletin 160 processes.

b. Works with Metropolitan Water District (MWD), whose regional planning models seem to have fewer problems than CALSIM II.

c. Works with CALFED, which uses CALSIM II for its studies.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Greatest need is for state's modeling efforts to include recycling, conjunctive use, conservation, the Colorado River and Los Angeles Aqueducts, and other supplies —local, regional, and statewide — that are "alternatives" to the SWP.

b. There is a need to have a statewide perspective, but this may best be gained from a network of smaller (i.e., local and/or regional) models as well as models for water supply elements (conservation, groundwater, etc.).

c. Water quality is an important consideration when estimating water quantity available for supply. As such, the state should address water quality as part of its water supply planning.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. It is possible that it would be less expensive and/or more effective to create a network of models (possibly including CALSIM II) to achieve the goals stated in question 2, rather than adding every feature in CALSIM II.

b. It would be good if CALSIM II were "one of many references," as is the case in Southern California, rather than serving as the sole basis for planning.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration,

software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. I assume CALSIM II does a good job of modeling the SWP.

b. CALSIM II is, however, too focused on the SWP, to the extent that it does not do justice to the rest of the "quite huge" water supply picture.

c. CALSIM II, as I understand it, does not represent local projects that contribute to the supply system. These include groundwater conjunctive use in Southern California, recycled water, dynamic representation of conservation, desalination of brackish water, etc.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. The biggest thing missing in CALSIM II is adequate information on groundwater and groundwater quality.

b. Would like the state to be able to model local contributions to supply (i.e., groundwater, recycling, conservation, desalinization, etc.), including interaction of these elements with economic incentives. There is systemic inertia with respect to some of these activities, such as conservation, so that an external stimulus may be necessary for change. MWD is attempting to model individual conservation devices that are part of their incentive programs, which will provide a more nuanced picture of conservation measures.

c. Use CALSIM II interactively with regional and other models that add features in which CALSIM II is weak.

d. Add the ability to incorporate water supplies/quality gains that go beyond best management practices. This might be done better in smaller scale models, rather than CALSIM II.

e. The more CALSIM II can resonate with reality at the regional level, the better. This fits with the current regional emphasis and the way that water systems operate in reality.

f. Hopes that CALSIM II will be flexible enough to show operational changes to the system as they are made.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Models used by MWD and the Los Angeles Department of Water and Power.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) *Is there anything else you would like to add regarding CALSIM II?*

a. CALFED Science Program should run a workshop for legislative staff and other consumers of CALSIM II who are not modelers after the peer review is completed.

b. The Legislature might be more supportive of funding for modeling if the subject were made less intimidating.

CALSIM II Interview Summary

INTERVIEWEE: Dan Steiner
AFFILIATION: Consultant
DATE: May 22, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Extensive work with the USBR and consultants on the development of the San Joaquin Valley representation for CALSIM II.

b. Extensive development and use of SANJASM and STANMOD (models of the San Joaquin Valley system).

c. Has interpreted and "borrowed" results from CALSIM, DWRSIM and PROSIM for post-processing analyses.

d. Development and use of a FORTRAN model for the upper Tuolumne River and New Don Pedro reservoir.

e. Developed a spreadsheet model of the Friant Division of the CVP, including Friant-Kern and Madera diversions. Assisted with the incorporation of a revised Friant Division depiction into CALSIM.

f. Utilized the CVOO CVP/SWP 12-month operations simulation model as an operator of the CVP..

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. NEPA and CEQA require that all users document actions and their effects on the "bigger system" (for example, the effects of water transfers, sales, and purchases, on water quality in the San Joaquin River at Vernalis). The state/federal models (e.g., CALSIM II) provide the tools to provide the analyses.

b. CALSIM II will be used to study the hydrologic effects of actions such as changes in flows and deliveries.

c. CALSIM II will be used for environmental documentations during permitting processes (e.g., FERC re-licensing, water transfers).

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. CALSIM II modeling will be required for almost regulatory forum, for water marketing, and adapting operations to future regulations or changes in regulation. Modeling will be used to show the impacts of new regulations on local agencies.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II is a work in progress. For example, the San Joaquin River system is currently being added to the model, and refined.

b. There is a lack of flow and water quality data needed to create a good representation of the system. This problem is not unique to CALSIM II.

c. The lack of water quality data hinders the integration of a water quality element into CALSIM II. For example, water quality requirements at Vernalis drive some of the operations at New Melones reservoir, but a lack of water quality data makes it difficult to accurately model the system.

d. There are limitations on the ability to disaggregate flow data spatially, which makes representing groundwater and other accretions difficult. Finer resolution in CALSIM II is required to model groundwater and surface water interactions, groundwater pumping, and return flows.

e. He has concerns about the ANN. He has heard that some results produced by the ANN do not match his understanding of how the Delta operates, but he has not specifically worked with or studied the ANN.

f. The addition of institutional accounting (e.g., B2 and EWA) into CALSIM II might come at the expense of losing the ability to model operations accurately.

g. He can understand FORTRAN and spreadsheet logic that works in a "straight path" from top to bottom. The LP solver "throws all the equations into a model" And solves them simultaneously. The weighting factors significantly influence the solution making their systematic ranking very important.

h. WRSEL language has some limitations in representing the system or processes. Although he is not a WRESL code implementer, he understands that there is a limitation on data table arrays.

i. The weights in the LP objective function drive the operations of CALSIM II. Minor changes can produce significantly different results. When a substantial change in results occur it may take significant effort to discover the cause. The user must be sufficiently aware of the processes to understand when the results might be amiss.

j. CALSIM II has a good user interface and display side tools. DSS seems to be a good medium to store the results.

k. The comprehensiveness of CALSIM II is a benefit (theoretically), but it also makes the model very complex. Users almost need to know what the results should be prior to running the model to see if the model behaves correctly (a form of verification).

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. More detailed resolution (spatially) in the San Joaquin Valley, especially in terms of water quality.

b. Additional monitoring data (flow and quality) to improve water quality modeling

c. Currently the demands and hydrology on the East Side of the San Joaquin Valley are land-used based, but West Side demands are still contract driven. The West Side needs to be converted into being land-use based as well.

d. It would be wonderful to add Tulare Basin, perhaps a long-term job. This would give a version of a true water balance for the Central Valley of California.

e. DWR has added a multi-celled groundwater component to the Sacramento Valley; a similar component is needed for the San Joaquin Valley.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. He would fall back on SANJASM and STANMOD to model the San Joaquin Valley.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) *Who else should we talk with about CALSIM II?*

9) Is there anything else you would like to add regarding CALSIM II?

a. After "walking away" from DWRSIM and PROSIM, CALSIM II is the only tool that people have to use. There has been a lot of time and money invested into this model. It is important for users and management to grasp what CALSIM II can, and can not be used for.

CALSIM II Interview Summary

INTERVIEWEE: Yung-Hsin Sun and Anna Fock
AFFILIATION: Montgomery-Watson Harza
DATE: July 11, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Previous hands-on experience with DWRSIM and PROSIM in support of Yuba County Water Authority. Developed a HEC5 model of the Yuba basin that was subsequently used in a SWRCB hearing on the Yuba River.

b. Used DWRSIM results and documentation.

c. Use CALSIM II for a number of studies, some of which required specific model development:

d. Implementation of Friant River Basin to investigate storage options.

e. Improvement of west-side drainage module in CALSIM II for computation of Vernalis water quality and upper San Joaquin storage analysis.

f. San Luis Low Point Improvement Project and San Luis by-pass.

g. Sacramento River Water Supply Reliability Study.

h. Used CALSIM software to simulate the PCWA raw water distribution system.

i. Also involved with CALSIM II for the Oroville FERC re-licensing.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. This office is more interested in using CALSIM II as a decision support tool. We do model development only to the extent it is necessary to do so for specific applications.

b. Use CALSIM II with IGSM and DSM2.

c. Use CALSIM II output as input to local agency distribution system.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Will continue to use CALSIM II for statewide operations.

b. Several future uses will require further development, particularly of the upper watershed representation.

c. Do not expect to use CALSIM II for real-time type analysis, but it can used for shorter time step.

d. Use CALSIM II to look at trends, and not specific months.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. The run time is too long. Can do at most eight runs of single cycle per day. A full multi-cycle run takes eight hours.

b. It is not an easy environment to debug. DSS output file must be opened to check the calculation.

c. Production of desired output is not straightforward.

d. The WRESL code is not flexible enough; in many situations it is necessary to trick the model or work around its limitations (e.g., extensive use of dummy variables).

e. On the flip side, because WRESL is not very powerful, it is very easy to learn, read, and understand.

f. CALSIM II is a good learning tool for California water system.

g. CALSIM II is the best model available of the CVP and SWP systems.

h. CALSIM II is much better than PROSIM and DWRSIM.

i. Not concerned with frequent model changes.

j. The users guide is very limited.

k. Many of the simplifications inherited from PROSIM and DWRSIM for local operations are still in CALSIM II.

l. Not concerned about model calibration. As a planning model calibration is not an issue, except in very specific, local cases (e.g., Friant Unit).

m. The XA solver is unstable. As open-source software, one should be able to take someone else's model and obtain the same results. The exact same model can be run in one machine but not another. Have not been able to come up with an explanation for this behavior. This instability reduces potential collaboration.

n. The debugger is very convoluted. Mass balance calculations need to be done manually.

o. Water demands in CALSIM II are based on contracts, rather than true demands.

p. Return flows are computed based on surface deliveries; however, they should be based on surface water deliveries and groundwater pumping.

q. The ANN module over-prescribes water needs to meet water quality standards.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Improved groundwater component.

b. Shorter time step. A daily time step would be particularly useful for TMDL water quality computations.

c. Better linkage of surface and groundwater.

d. The Vernalis water quality calculations require further improvement.

e. The Friant Unit should be included in the next public release of CALSIM II.

f. The operation of upper basins needs to be fully implemented in CALSIM II. Pre-operation of these basins, results in major problems.

g. The ANN module needs to be improved as it over-prescribes water needs.

h. The user interface is very clumsy. Existing GUI does not allow for data extraction in columnar format.

i. CALSIM II should move away from DSS and use better databases (other proprietary databases might be too expensive).

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Excel spreadsheets.

b. For many projects an accepted tool must be used. Otherwise, would develop something else depending on project.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) *Who else should we talk with about CALSIM II?*

9) Is there anything else you would like to add regarding CALSIM II?

a. CALSIM II is a good learning tool. Its open-source environment is a great improvement over DWRSIM and PROSIM. This is a major accomplishment, as it brings more people up to speed in terms of system operations. However, as with all models, it still needs further development.

b. CALSIM II has an "image issue". Several people insist that, unless CALSIM II has a static benchmark study, the model cannot be used. This should not be the case for many studies.

c. Too many people are trying to use CALSIM II to answer "all the questions in the universe." No model can do that. The focus of CALSIM II should be on comparative studies, not absolute values.

d. Planning should lead model development. Model is a supporting tool only.

CALSIM II Interview Summary

INTERVIEWEE: Robert Tull (RT)
AFFILIATION: CH2M-Hill
DATE: June 10, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. He has been involved in the development and application of CALSIM II.

b. Participated in the CALSIM II Benchmark Study team and the Technical Coordination Team.

c. CH2M-Hill has used CALSIM II on approximately 10 projects that range from writing new code to applying CALSIM II to specific projects to conducting educational workshops for USBR.

d. Currently developing links between CALSIM II and DSM2. Extended the scope of DSM2 to encompass the full 73-year span of available data.

e. Previous modeling experience includes using PROSIM to model the SWP/CVP system for the CVPIA as well as development of Hetch Hetchy system operations model and a model of the Central Utah Project.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Up until 2003, most of CH2M-Hill's work on CALSIM II consisted of model development and general studies.

b. Since approximately January 2003, CH2M-Hill's work has focused on application of CALSIM II to specific projects, including the Trinity River EIS, Freeport Regional Water Project, and the Operating Control and Plan (OCAP) for the CVP.

c. CH2M-Hill continues to work on developing CALSIM II for application to specific projects.

d. CH2M-Hill runs CALSIM II in conjunction with DSM2, temperature models, and power analyses

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. CH2M-Hill will continue to focus on applying CALSIM II rather than working on general model development. Further development is likely to be specific to needs for individual applications.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. There has been too much work to develop the "bells and whistles" of CALSIM II and too little on the hydrology.

b. CALSIM II's hydrology is holding the model back. The basis for the hydrology is dates back to the 1960s and is far behind the rest of the model. However, some improvements have been made in the joint (DWR and USBR) hydrology; CALSIM II's hydrology is a better representation of reality than PROSIM due to a more discrete node network.
   - o The CVGSM results used to characterize the groundwater/surface water interaction in the Sacramento Valley need to be refined. Characterization of return flows needs improvement. The current representation assumes that return flows occur in the same month.
   - o On-farm efficiencies are based on calculations from the 1960s, while actual efficiencies have improved considerably since then.
   - o CALSIM II's current depletion analysis is very gross.
   - o A finer geographic representation of hydrology is required.
   - o The land use based hydrology in the San Joaquin Basin is an improvement.
   - o Hydrology building blocks must be transparent to model users. All hydrology should be thoroughly documented.

c. Improvements to CALSIM II seem to focus on "specific areas." As a result, areas that do not receive attention fall behind and cannot support the refined areas adequately.

d. Representation of the Environmental Water Account needs improvement. The EWA is difficult to model, but the current representation makes it difficult to compare studies.

e. The ANN's behavior needs refinement. The ANN can only be as good as DSM2. Hopefully the CART process will help with this problem.

f. CALSIM II still includes many step functions. Small change in input can result in large differences in output.

g. Documentation for CALSIM II is limited. The model's hydrology and the ANN are in particular need of more complete documentation.

h. The CALSIM II engine does not tell the user what parameter is constrained in a run. Because of the model's formulation, users have to "dig" for this information. CALSIM II requires a second step to extract information for a sensitivity analysis.

i. It is easy to have the results of a CALSIM II run fall within the "noise" of other water being moved around for (b)(2) and EWA, which may obscure the effect of the change to the system that is being modeled.

j. CALSIM II was described as a model that can be "run on your kitchen table." In practice, however, CALSIM II is a difficult model to learn. It takes at least six months of experience to be able to determine if results and assumptions are reasonable. Much of the burden falls on the person doing the analysis. It takes considerably more effort to learn CALSIM II than it did PROSIM or DWRSIM.

k. Recent applications of CALSIM II have drawn close scrutiny due to litigation, which has led to a better understanding of the model and the parameters that drive results.

l. People are now looking at CALSIM II results in individual months. CALSIM II was designed to be applied on a more planning level "statistical basis," providing information on general trends.

m. Some people want to use CALSIM II as an operations model, some as a broader, future predictive planning tool. This represents a huge range of expectations to be met by a single tool.

n. Some people are not comfortable with not being allowed to accept CALSIM II results as absolute.

o. CALSIM II still has some credibility issues. Some water districts still use DWRSIM because they trust and know the model. DWR's historical verification should help with this.

p. A two-day training class is not sufficient to learn how to use CALSIM II. There is too much of both the model and the physical system to learn. Current workshops focus on running CALSIM II, rather than on understanding its results.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Hydrology should be created from land use up. In the current hydrology, it is impossible to see many of the building blocks and to see how the puzzle

comes together. It is complex to understand how water balances are maintained.

b. Land use based hydrology should be added to the west side of the San Joaquin Valley.

c. Integration of CALSIM II and IGSM/ CVGSM would be great. However, it is necessary to understand how the groundwater/surface water interactions work before the models are joined.

d. Incorporation of economic models into CALSIM II would allow demands to respond to a non-static system. This might not happen in CALSIM II at all, but rather in the next generation model.

e. CALSIM II needs more documentation throughout. The DWR/USBR documentation and review process that is currently underway is very important.

f. Somebody needs to take on the task of providing user support for CALSIM II.

g. CALSIM II needs something equivalent to the user support group that exists for IGSM.

h. A mechanism is needed to bring non-modeling people to an adequate level of comfort with CALSIM II. Such a mechanism would include conveying the model's complexities and helping people develop reasonable expectations of how they can use CALSIM II.

i. The agencies need to listen more to feedback regarding improvements to CALSIM II. The more people are included in the review process, the better the model will be.

6) *If CALSIM II were unavailable for your purposes, what would you use?*

a. PROSIM, DWRSIM, or ECOSIM. One could code (b)(2) and the EWA into the older models. There are many ways to model the same system.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) *Is there anything else you would like to add regarding CALSIM II?*

a. CALSIM II is a good and reasonable tool. Results are meaningful if they are applied carefully. DWR and USBR deserve a lot of credit for working hard to make CALSIM II the best tool possible. It is "almost an impossible task" to make everyone happy.

b. The fact that CALSIM II is the best tool available is no longer enough.

c. CALSIM II has a lifespan of five or six years until it will be time to move on to the next tool. The model's overhead will get to be too much and it will need a new foundation. It is time to start thinking about this now, although time and money are not available for such a creative process. It is important to think about what we will need and what questions will be asked 10 years from now.

d. The successor to CALSIM II will need a cleaner formulation (LP or other) that allows for more computational efficiency and better representation of the system.

e. CALSIM II's successor should be built from land uses up, depicting real water, basin interactions, and groundwater/surface water interactions.

f. Public expectations of CALSIM II are very high, which can fuel frustration and criticism of the model.

g. It is difficult when CALSIM II is used politically rather than as a technical tool. It is then no longer an issue of how good a technical tool it is.

h. CALSIM II is not a calibrated, validated model. The quality of results is dependent on how the model is run. Experience is required to both run and understand CALSIM II. The learning curve associated with CALSIM II is a function of the complexity of the Central Valley system as much as of the complexity of the model.

CALSIM II Interview Summary

INTERVIEWEE: Deven Upadhyay
AFFILIATION: Metropolitan Water District (MWD)
DATE: May 30, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. As an end user of CALSIM II, he takes the output from CALSIM II (previously DWRSIM) and uses it as input for State Water Project supplies into more local models (IRPSIM and IRPDSM).

b. Has had exposure to CALVIN and MWD's integrated resources model (IRPSIM) and internal distribution system optimization model (IRPDSM).

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Uses CALSIM II to characterize supply profile from the SWP.

b. Uses results from full entitlement model runs to identify water quantity, quality and conveyance capacity needs for water transfers.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Additional uses would depend on where CALSIM II is going in the future. Currently CALSIM II operates very differently than MWD's model, especially with regards to hydrology through time. If the models become more compatible in this regard a more complete and direct integration of models might be pursued. Currently, there is a lot of "kluge" iteration between CALSIM II and IRPSIM model runs for some of MWD's purposes.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II has never been "marketed" as a predictive tool, but MWD already uses it in a predictive manner. MWD might develop its own predictive tool if CALSIM II cannot be supported as a predictive model.

b. Updates to the CALSIM II hydrologies have tended to greatly affect results for wet and dry year extremes. The loss of the Colorado River supplies has

placed more focus on SWP reliability and what the worse case scenarios are. Because of the continual updating of CALSIM II the worse case scenario changes considerably, making it difficult to determine what could or would happen under adverse conditions. It is hard to go before a Board if the results of the analysis are changing.

c. Getting a new model run from DWR is a very lengthy process. MWD must often make decisions in a shorter time frame. CALSIM II runs are generally just one component in a study, but are necessary, so delays from DWR hold up the entire process. MWD may need to create a "CALSIM II simulator" to enable them to perform their studies in a timelier manner.

d. There are concerns with the way CALSIM II deals with the EWA. Perhaps DWR needs to "take a stab at" where the EWA will be in the future.

e. CALSIM II only looks at one level of development for the entire period of hydrologic record. MWD needs to model different hydrologies through time, as demands evolve spatially and temporally. This is especially true for looking at conveyance and treatment issues for growing inland demand areas.

   - Currently MWD must take CALSIM II results/deliveries and fit them into MWD's modeling framework. This a "necessary misuse of CALSIM II results that could potentially drive a change" in modeling.

f. CALSIM II is a good tool for making a point-in-time comparison for a particular policy or change. However, a predictive tool is still needed.

g. A smaller time step is needed to represent the operations of the State Water Project. If CALSIM II could be run on a shorter time step (i.e., weekly or less) it would make comparisons with other planning and operations models easier.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. More outreach is needed. A general summary of where the model is now and what is being done needs to be sent out to interested individuals. An email newsletter could do this.

b. There should be a technically focused user group and forum both for training and development. This forum needs to be well structured and not just a place to voice complaints. It needs to have technical people involved that can provide and help develop solutions/suggestions to issues of concern.

c. Modifications are needed to make CALSIM II move through time rather than assume a static level of development. This would make the model more compatible with modeling done at MWD.

d. More work needs to be done to estimate what supplies will be available to State Water Contractors. In other words, work needs to be done to make CALSIM II a predictive tool.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. If CALSIM II were unavailable, MWD would create their own model to forecast SWP supplies, probably by modifying a general IRPSIM. There is already some talk of doing so, despite the existence of CALSIM II.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) *Who else should we talk with about CALSIM II?*

9) Is there anything else you would like to add regarding CALSIM II?

a. The interview process is encouraging because it a type of outreach. It is good to identify the shortcomings of CALSIM II.

CALSIM II Interview Summary

INTERVIEWEES: Peter Vorster
AFFILIATION: Bay Institute
DATE: May 20, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. He was originally hired to "penetrate the black box" of California water resources models.

b. He spent time with Spreck Rosekrans and David Briggs examining DWRSIM and evaluating alternative scenarios.

c. He participated in or is very familiar with several CALFED gaming exercises (e.g. EWA and Sites Reservoir gaming).

d. He is primarily a user of CALSIM II results.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. CALSIM II results are used as input for other more local studies, particularly the San Joaquin Water Supply studies and the Upper San Joaquin Storage studies

b. His interests include the evaluation and understanding of how various North of the Delta projects would impact: the Bay-Delta system, the south Delta, and the San Joaquin River operations.

c. The Bay Institute is interested in seeing if CALSIM II can be used to evaluate the recirculation of San Joaquin River water at the Delta or points upstream.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. To evaluate impacts of water transfers from the Sacramento Valley on the Bay-Delta system, the south Delta, and San Joaquin River operations.

b. He would continue to use CALSIM II for additional gaming exercises.

c. The Bay Institute is interested in seeing if CALSIM II can be used to evaluate the recirculation of San Joaquin River water at the Delta or points upstream

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can

include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. He doubts that CALSIM II can be used to simulate Article 21 and re-scheduled water. A smaller time step would be required for these studies.

b. The representation of groundwater in CALSIM II is weak and needs to be improved.

c. Tulare Basin hydrology, reservoir operations, and water demands must be included in CALSIM II to make it more useful.

d. Users should be able to easily evaluate different water demand scenarios.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. Expansion of CALSIM II to include the Tulare Basin, so coordinated operations of the Tulare Basin and other parts of the system can be simulated.

b. Better linkage between CALSIM II and gaming exercises.

c. Updated CALSIM II runs and CALSIM II staff participation in gaming exercises.

d. A smaller time step, possibly daily, would be required to simulate Article 21 and rescheduled water.

e. CALSIM II should be able to model water exchanges between MWD and the Friant and Kings River systems and the integration of those exchanges into the SWP system.

f. CALSIM II should have a better representation of the linkages between the East and West sides of the San Joaquin Valley.

g. It would be good to test if the model is capable of simulating generalized historical operations. If so, confidence both in CALSIM II and the use of a monthly time step would be increased.

h. Water quality (salinity) and hydrodynamics (stage) should be added to CALSIM II, especially on the San Joaquin River, at least up to the Mendota Pool.

i. There should be on-line tutorials for CALSIM II, both for model users, as well as users of model results. Not everybody who would like to understand the model and its results can attend workshops.

j. There needs to be better communication regarding how data should be used and interpreted.

k. Key assumptions in CALSIM II model and runs must be clearly spelled out so that CALSIM II is not viewed as a "black box".

l. Groundwater simulated dynamically in CALSIM II. A simplified groundwater representation would be an improvement on current representation.

m. He would like to unimpaired flow data reflecting pre-development conditions rather than a particular level of development.

n. There is a great interest in the public interest sector regarding X2 and salinity conditions in the Bay.

Develop consensus alternative demand scenarios that can be easily incorporated in model runs.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Models developed by other private and public entities.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

CALSIM II goes through so many changes that it is hard, if not impossible, to keep track. This process should be improved. CALSIM II is developed in a relatively more open and transparent process than any other model, which enhances its acceptability. The transparency of its development should not be diminished and should be enhanced wherever possible.

CALSIM II Interview Summary

INTERVIEWEE: Chuching Wang
AFFILIATION: Metropolitan Water District (MWD)
DATE: May 8, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. Since 1995 he has been involved with Bay-Delta modeling analyses that include DWRSIM and/or CALSIM II for long term planning studies, including water quality and water quantity analysis.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. MWD uses CALSIM II for long-term planning analyses, mostly concerning the State Water Project (SWP) operation and water supply and water quality impacts associated with potential CALFED actions, regulatory scenarios, and operational strategies. For the CALFED ROD evaluations, his group uses CALSIM II as one of the integrated analytical tools. Coupled with six other models, they translate potential CALFED actions into benefit/cost information by analyzing the avoided resources procurement cost, the avoided treatment costs and the reduced salinity damage cost.

b. His group uses CALSIM II primarily for comparative analysis for project comparison and evaluation.

c. CALSIM II is used as a part of an integrated modeling approach to provide benefit estimates. It is used in conjunction with the:

- Fisher-Delta Model and/or DSM2
- San Luis Reservoir and O'Neill Forebay Blending model
- Central Valley water quality exchange model
- IRPSIM model
- Water quality treatment cost estimation model.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. CALSIM II will be used to evaluate CALFED options in an attempt to find the best program features for MWD and California water industry.

b. CALSIM II will be used to evaluate operation strategy to improve the water projects efficiency.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. It is relatively easy to adapt and change CALSIM II to reflect new regulations.

b. Data structure is much better than before.

c. It is "good" that the federal and state agencies and MWD use a standard tool to model the state and federal projects and produces more "consistent study results".

d. CALSIM II is much easier to represent many constraints than DWRSIM.

e. He has concerns regarding potential systematic errors in the model. A "second opinion" would be useful in such instances.

f. The flow-salinity relationships in CALSIM II need to be improved, especially with respect to export water quality.

g. Much experience is needed in setting the priority weights. There is no standard way to establish the weights, resulting in a trial and error process.

h. Every time a new facility or demand is analyzed, the water –supply index-demand index curve (delivery logic) needs to be re-calibrated. The re-calibration feature within CALSIM II needs to be triggered manually or the results may be inconsistent.

i. CALSIM II requires a commercial solver (XA solver), resulting in licensing issues and rising costs to use the model. There have been a lot of delays in the benchmark study because of required XA modifications.

j. The user interface is "pretty handy" for basic operations, but for more complex operations it needs to be improved.

k. The model is "risky" in predictive mode. It is better for comparative analysis.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

MWD is doing some source code improvements in CALSIM II, which include:

a. Incorporate new flow-salinity relationships based on multi-component non-linear regression relationship.
b. Improve and increase CALSIM II capability of doing water quality tracking by ending and mass balance
c. Some other potential development works include:

d. Consider replacing the current linear programming engine by public domain freeware.
e. Consider re-coding to allow for parallel processing, to make the model more efficient.
f. Improve data transfer efficiency between the each of the 5 modeling layers.
g. Modify data structure and formulation to allow multiple traces simulation.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Either use DWRSIM or "back of the envelope", or "screening tool".

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

a. Provide and enhance the training program.

b. Expand the professional support base.

c. Create tool to generalize the QA/QC process.

d. Activate a user group to share CALSIM II development and application issues.

CALSIM II Interview Summary

INTERVIEWEE: Bob Wilkinson
AFFILIATION: University of California, Santa Barbara
DATE: August 28, 2003

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

a. Looks at how models, including CALSIM II and their output are used for statewide planning (including Bulletin 160), reliability studies (including the SWP Reliability Study), and CALFED.

b. Has reviewed IWRMAIN and MWDMAIN in the past, looking at their application within an urban boundary.

c. Does not use CALSIM II directly.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. Is interested in "macro-level" planning decisions and processes that are based on the results of models such as CALSIM II.

b. Has been involved with Bulletin 160 process, the SWP Reliability Study, and with CALFED projects, all of which use CALSIM II.

c. In general, he looks at "what people do with CALSIM II" and considers whether or not those uses are appropriate.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Anticipates that others will continue to use CALSIM II in the future, although he will not be using the model directly.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. CALSIM II benefits from the fact that many good people have worked for a long time on both it and its predecessors (e.g., DWRSIM and PROSIM).

b. Both DWRSIM and PROSIM were designed for specific applications and to be used in comparative analyses. Present modeling needs and purposes have evolved over time and differ from previous modeling needs. There may still be need for comparative analysis, but he questions whether the design and architecture of CALSIM II, which is based on its predecessors, is serving the current needs and purposes such as to forecast SWP supply reliability, macro level planning decisions, Bulletin 160, and policy questions currently facing the State of California.

c. Input data are inadequate, particularly for groundwater.

d. CALSIM II requires large quantities of data of many varieties. This significant requirement for the model should be discussed.

e. CALSIM II needs a shorter time step. A monthly time step may be sufficient for comparative studies, but a daily or possibly and hourly time step is necessary for management decisions such as pumping. CALSIM II needs to be able to capture high flow events using a short time step.

f. Both the CALSIM II model and the associated data coverage should be extended to include the area south of the Tehachapis. CALSIM II does not address stormwater capture, groundwater, water use, etc. in southern California.

g. CALSIM II should use economics and price into its demand-side aspects. Only then will CALSIM II be useful for policy purposes.

h. CALSIM II is transparent but not accessible or user-friendly.

i. The need for a good model of California's water system is critical, and so planners should be careful to consider the full range of questions and objectives that such a model might address. It is important to ask if CALSIM II is the right tool to answer these questions or if we should start again from scratch with a new model.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. There should be more dialog among agency modelers and CALSIM II developers regarding the derivation of inputs to CALSIM II and the use of its outputs. There is an entire cluster of interrelated models (e.g., CALAG), all of which would benefit from a discussion of limitations of each model and how these limitations affect the other models.

b. There should be a stakeholder group to examine data on both groundwater and surface water and to determine where data are good, what needs work, and what kinds of work are necessary. This issue is larger than just CALSIM II.

c. There should be an open process to determine the appropriate or ideal time step for CALSIM II. Would a daily time step be short enough? If not, how small a time step is necessary, and what would it take to implement such a time step?

d. Error bands and indications of the appropriate degrees of uncertainty associated with various CALSIM II outputs would be helpful. Some outputs may merit different levels of confidence, all of which should be indicated explicitly.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. Would like to scope an appropriate system model to build a better understanding of the supply and demands within the system, with transparency for policy and planning needs. He would like the agencies to rethink modeling needs according to the policy and management questions to be answered, and then allocate the appropriate funds to develop such a model over a five-year time frame.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

We need to be careful enough to step back from CALSIM II, and all the time, effort, and resources already spent to think about long-term needs. The need for a good model is critical. We should ask ourselves if CALSIM II is what we want to "stick with" or if we should go in a different direction and create an entirely new tool.

CALSIM II Interview Summary

INTERVIEWEE: Mark Williamson (MW) & Brian Van Lienden (BVL)
AFFILIATION: Saracino-Kirby-Snow (SKS Water)
DATE: May 15, 2003

1) *Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?*

a. MW has worked very indirectly with CALSIM II. Previously, he worked in depth with PROSIM (modifying code, creating input files, and running the model) for projects at EBMUD.

b. BVL is in the process of learning to use CALSIM II. He has also been reviewing results and preparing summaries of input and output data from CALSIM II. Previously he has worked with DWRSIM, coordinating model runs and interpreting results.

2) What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)

a. SKS Water has been using CALSIM II for CALFED studies: North of Delta Storage Study, Common Assumptions, and the CALFED Water Management Strategy. The CALFED Water Management Strategy involves using LCPSIM, CVPM, CVGSM, DSM2 and CALSIM II. SKS Water has been coordinating data sharing/transfers and looking at model run results.

b. SKS Water is also using CALSIM II output for project-specific impact analysis for a variety of clients

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

a. Future use of CALSIM II depends on the budget. Most likely use will continue for studies such as the North of Delta Storage project and work on building the common assumptions to develop a base case.

b. EIR impact analysis for clients north, south and within the Delta.

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

a. An improvement over previous models, CALSIM II is a joint USBR and DWR model so it has a common data set. It is the only model of the state and federal system.

b. CALSIM II is an improvement over PROSIM. It has eliminated the "step functions."

c. It is relatively easy to modify the system, but this also makes it difficult to keep track of all the changes that have been made to CALSIM II.

d. CALSIM II has a relatively small pool of users (i.e., experts) who can run and use the model because it is continually changing. Changes in the model are very rapid, resulting in only a few people who are "up-to-date" on CALSIM II. As a result, issues of data handling, version control and many potential studies cannot be addressed.

e. CALSIM II is a "creeping" model (i.e., it is constantly in a state of flux).

f. CALSIM II is a very complex modeling tool. It is really the only tool that can model the state and federal system, but it is not finished. DWR is continually modifying the model. Local users need to do studies soon and cannot wait for a "finished model."

g. CALSIM II lacks a base case or benchmark study that is supported by DWR or other responsible agency that can be relied upon as a defensible basis for impact studied. Modelers agree that such system-wide models are not useful predictors of absolute system performance (e.g. flow will be 100 units), but rather should be used to show system changes due to model inputs (e.g. flow will increase 10 units) – this is not possible without a defensible base case that the responsible agency will stand behind.

h. CALSIM II needs to improve the way things are represented, but improvements need to be weighed against the need for a finished model.

i. The software environment of CALSIM II is much better than that of DWRSIM, but the data management structure is still very poor.

j. CALSIM II now has an LP solver, which creates the potential for multiple solutions. Setting of objective function weights too closely for several contractors within the same priority class might lead to arbitrary selection of the optimal solution (i.e., the solution might 'bounce' between very different corner points for small changes in inputs or re-ordering of constraints). This complicates the problem of showing impact of implementing an action, and may make defense of a model study (e.g. in a court of law) difficult or ambiguous.

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

a. DWR needs to consider investing more money and resources into training new users. This could be an allocation of resources problem.

b. Certain types of data are always passed between CALSIM II and other models. CALSIM II needs to be able to automatically generate the required output in the correct format for input to other models. This will help to reduce user caused errors.

c. A CALSIM II user group is needed for training new users and providing a forum for discussing various issues. It would help to dispel the perception of a "closed shop."

d. A better data management system and a data interface are needed.

e. DWR needs to develop meta-data and documentation and continue to maintain it in the future.

f. DWR needs to produce a CALSIM II base case study that represents the current "state of affairs" (e.g., "base case for the next 5 years"). The benchmark study is a step toward this, because it is an agreement on system operations.

g. The development of a web site that would enable users to log in (unique user identification) and obtain updates. The login would help with version control and would make reproduction of assumptions and results easier.

6) If CALSIM II were unavailable for your purposes, what would you use?

a. DWRSIM. There really is not an alternative to CALSIM II that is available.

b. PROSIM .

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

No.

APPENDIX G: SUMMARIES NOT FOR ATTRIBUTION

The following appendix contains the written summaries for the interviews conducted not for attribution. The responses to questions #7 and #8 were omitted.

CALSIM II Interview Summary
NOT FOR ATTRIBUTION

1) Briefly, what has been your involvement with the CALSIM II model and other computer models of major California water operations?

1. He has had very little experience with CALSIM II directly, but has had extensive experience with DWRSIM output.
2. He has worked extensively with numerical and physical models of the Delta for planning purposes.
3. He has worked on development of the CALSIM software (CALSIM is the software and CALSIM II is the latest application to the CVP/SWP system).
4. He has worked on hydrology development for CALSIM II (revising method of calculating local accretions/depletions and estimating local land-use based demands).
5. He implemented the current groundwater module in CALSIM II.
6. He worked with other staff on the historical operations study as part of an evaluation of the model.
7. He has helped develop and used CALVIN.
8. He developed a Stella model of the Klamath Irrigation Project
9. Earlier involvement with DWRSIM applied to planning studies such as Los Banos Grandes and CALFED.
10. Involvement with CALSIM II as an observer. Relies on others to provide results for major planning studies.
11. Prior to 2000, worked primarily on Delta and Suisun Marsh studies. Basic knowledge of DWRSIM; used its output as input for other models.
12. Since 2000 has been involved in stakeholder/user forum with CALSIM II through the Bulletin-160 modeling group.
13. Has peripheral knowledge of CALSIM II
14. Has worked with all the major models from the late 1960's/early 1970's.
15. Involved in CVP yield studies.
16. Indirect involvement in DWRSIM for COA negotiations.
17. Used PROSIM extensively. Still uses PROSIM to obtain results quickly. It is much easier, faster, and cheaper to run PROSIM.

18. In numerous studies, PROSIM is used to get close to the answer and CALSIM II is used for a final run. Developed the interface with the ANN and the CALSIM engine.

19. Worked on data input, particularly those regarding Delta issues, rule curves, and allocations

20. Has been involved with the development of a daily time step.

21. Has been involved in Delta storage studies.

22. Maintains model and make sure that all components work well together.

23. Helped derive the weight structure.

24. Previously worked on DWRSIM, HEC-3, and HEC-5 applications to the Yuba and Bear systems.

25. Uses CALSIM II output as input to DSM2.

26. He has been a developer and user of CALSIM II since its inception and previously also with DWRSIM and PROSIM. Involved in the initial CALSIM meetings with Francis Chung and George Barnes. Coordinated with DWR to create a joint model.

27. Worked on the Benchmark study, Shasta enlargement, and some work on the San Joaquin River representation in CALSIM II.

28. Worked mostly on model development.

29. For the last two years has been the USBR point of contact for CALSIM II.

30. Participated in the joint development and applications coordination meetings.

31. Worked on developments or San Joaquin River basin 2030 hydrology and operations refinement.

32. Currently team lead for USBR/DWR documentation and review of CALSIM II.

33. Some agencies and districts have only read and heard a little about CALSIM II, and rarely (or never) operated the model. There has been some use of CALSIM or CALSIM II as a simulation model for certain specific situations.

34. His experience with CALSIM II began in 2002 with his current work for CVP Operations. He uses model results for analyses of the effects of proposed projects and management options.

35. Provides feedback to CALSIM II developers regarding potential improvements to the model.

36. Worked with CVP and SWP simulation models since 1985. Generated input for these models.

37. Developed spreadsheet for simulating COA, and seasonal forecast operations model.

38. Has a general familiarity with CALSIM II.

39. Is a proponent for using CALSIM II for position analysis for operational purposes.

40. For the past 18 months, SP has worked exclusively with CALSIM II, mainly performing CALFED ROD studies.

41. Developed study specific modular code to simulate single CALFED ROD alternatives or in combination.

42. Worked as a developer of DWRSIM.

43. Used both PROSIM and DWRSIM extensively.

44. Has been involved with CALSIM II since 2001, when DWR released CALSIM II example studies that demonstrated model functionality.

45. Spent approximately one year performing QA/QC on the entire CALSIM II model (input data, hydrology, reservoir balancing, allocation logic, etc.).

46. With DWR, USBR, and other consultants, participated in defining common assumptions to be used in the Benchmark studies.

47. Reviewed the ANN and its implementation in CALSIM II.

48. With USFWS and CVP Operations, reviewed the representation of (b)(2) in CALSIM II.

49. Applied CALSIM II in a comparative study on climate change impacts to water resources of the San Joaquin River region. Changed inputs into the model, but did not alter the WRESL code.

50. Developed the inflow forecast data for New Melones Reservoir and Stanislaus Basin allocation logic.

51. Currently working on model development, focusing on the Environmental Water Account (EWA).

52. Sat in on meetings of the Benchmark Study Team, Technical Coordination Team, and the predictive applications (ex., CVP OCAP).

53. He has been the supervisor of CALSIM II modeling group since 1998. Performs quality control on work produced by his group.

54. His group also uses water temperature models.

55. Managed CH2M-Hill's contract to work on CALSIM II development.

56. User of CALSIM II results for analysis of the impacts of projects and operations on deliveries and of opportunities to reduce those impacts.

57. Has no experience with previous or similar models (e.g., PROSIM or DWRSIM).

58. Involved with CVP/SWP models since 1994, when was asked to review PROSIM for use in environmental compliance analysis.

59. Implemented the G-Model in PROSIM.

60. In 1996 recommended the use of an alternative modeling environment to replace PROSIM's "spaghetti-code". Investigated the use of MODSIM to simulate the CVP.

61. In 1997 USBR decided to drop MODSIM and join DWR in developing CALSIM II.

62. In the past two years, worked on CALSIM II development and maintenance, and the Benchmark Study.

63. Also worked with SANJASM, STANMOD, and to a lesser degree with DWRSIM. He worked directly with USBR since 1987. Has done some work on the SANJASM model.

64. Used SANTUCM (SANJASM + IGSM) to look at selenium drainage options for the west side SJV

65. Helped organize and attended CALSIM II training classes, but is not currently a direct user of the model.

66. Led a team that used CALSIM II for an EPA sponsored study on global climate change. Worked in the modeling branch for six to seven years.

67. Was head of modeling studies using DWRSIM and CALSIM II.

68. Used other models (e.g. HEC) extensively.

69. Provided much input on the early stages of CALSIM II development.

70. Worked on the CALSIM comparisons to DWRSIM.

71. Worked on carryover storage indices.

72. He has used the aggregated output from CALSIM II and DWRSIM as inputs into the CVPM (Central Valley Production Model), LCPSIM (Least-Cost Planning Simulation) models.

73. He is a member of the DWR-USBR study management team, investigating increased storage in the Upper San Joaquin River Basin. CALSIM II is being used as the primary analysis tool used to determine the hydrologic ability of the alternative storage projects to provide San Joaquin River restoration flows.

74. Developed HEC-5 simulation models of Enlarged Shasta and Fine Gold Creek Reservoirs.

75. Developed an HEC-5 flood control model of the Sacramento Basin for the Corps of Engineers.

76. Provides "big picture" guidance on the use of CALSIM II and works with results. He does not run CALSIM II.

77. Has worked to refine assumptions included in inputs to both PROSIM and CALSIM II to reflect changes to the system caused by new and proposed facilities. This work has included comparing model results of runs representing the system both with and without the project in question and checking to ensure that results make sense.

78. Worked in DWR's Modeling Support Branch when CALSIM II was developed as a tester of the model.

79. Has used CALSIM II to run studies for various projects.

80. Has used DWRSIM to run studies.

81. Main involvement has been as facilitator of understanding and communications between the many parties interested in CALSIM II studies, including project planners, stakeholders, regulators, project operators, and consultants. Explains data development, logic, and assumptions to the various parties.

82. Involved mostly in CALSIM II results interpretation rather than modeling and code development.

83. Previous involvement with DWRSIM, PROSIM, and stochastic hydrology.

84. Use CALSIM II for analyses related to FERC re-licensing of Oroville Dam.

85. Use CALSIM II for various operations planning activities. The SWPOCO has provided CALSIM II developers input regarding how to emulate SWP operations more accurately for the latest update to CALSIM II.

86. Develops scenarios for and runs CALSIM II. Was involved in the development of DWR's COLOSSUS model.

87. Prepares and executes CALSIM II runs for various people in the Operations group. Also provides input to CALSIM II developers regarding bugs and technical difficulties in running the model.

88. Use DSM2 to forecast and hindcast conditions in the Delta for operations planning purposes and to check the performance of DSM2.

89. She and others in the Delta Modeling Section have been using the CALSIM model for several project studies and also in CALSIM development, primarily developing water quality relationships in CALSIM II.

90. Involved for 11 years in the development of the hydrology input for CALSIM II and DWRSIM.

91. Part of the joint DWR/USBR group that developed the CALSIM model.

92. Involvement with support models includes the Depletion Model, HEC3, Consumptive Use Model, COMP (a general purpose spreadsheet model to develop certain aspects of hydrology), and multiple-cell model.Participated in developing resource simulation and water distribution models.

93. Participated in reviews of CALSIM I, but not in the development of CALSIM II.

94. Stopped running models approximately four years ago. Does not run CALSIM II but oversees those who do and the use of CALSIM II output in conjunction with other models

95. Involved in correcting CALSIM II's representation of the Stanislaus River.

96. Previous involvement with SANJASM and STANMOD, the latter is a spreadsheet model of Stanislaus River operations.

97. Worked on CALSIM II development, specifically on the implementation of the LP engine and also some model validation.

98. Worked with PROSIM, DWRSIM, and Reclamation's water temperature and fish mortality models. With PROSIM worked on making the model more consistent with operations.

99. Used PROSIM and DWRSIM to evaluate secondary impacts of proposed projects or regulatory action.

100. Worked on the Los Vaqueros water quality-blending model for the Los Vaqueros expansion. Also worked on the original Los Vaqueros Reservoir analysis.

101. Worked with the CVP forecast model to determine CVP water allocations.

102. Reviewed model runs to ensure that model simulations reasonably reflect actual operations.

103. Worked on the implementation of B2 and CVP operations/allocation in CALSIM II.

104. While a CVP operator, wrote the CVOO forecast model.

2) *What specific interests, uses, and applications do you and your organization most frequently have for models such as CALSIM II? Do you use CALSIM II with other computer models, perhaps as a source of deliveries for more local models? Please be specific regarding your current and likely applications and uses of CALSIM II. (E.g., general water supply and flow patterns, project deliveries to a local region, environmental flows, etc.)*

1. He has used the output from DWRSIM model runs as inputs into long-term hydrodynamic and water quality models of the Delta. Results from DWRSIM (and eventually CALSIM II) will be useful for setting the boundary conditions for the Delta models for impacts analysis of proposed changes in hydrology, operations, or hydraulic control structures
2. CALSIM II is currently being used for a variety of studies and projects:
   - SWP delivery reliability studies
   - ISI: North of Delta Offstream Storage and In-Delta Storage.
   - South Delta Improvement Program, increasing permitted pumping capacity at Banks to 8500cfs (and potentially up to 10,300cfs).
   - FERC re-licensing of Oroville.
   - The Monterey Agreement EIR/EIS.
   - California Water Plan Update, Bulletin 160-03.
3. Three hydrologic models are used to develop the hydrologic inputs for CALSIM II:
   - The Consumptive Use Model to develop the agricultural and urban consumptive demands.
   - The Depletion Model to estimate outflows from upstream watersheds (those outside of CALSIM II) at a projected level of development.
   - A Comp Model to combine timeseries data.
4. Four local agency models also are used in conjunction with CALSIM II:
   - CCWD has a local model to provide a time series of net deliveries from the Delta.
   - EBMUDSim provides Pardee inflows, urban diversions and downstream diversions from the Mokelumne River. .
   - MWD uses IRPSIM to develop a time series of Table A demands, but does not iterate these demands with CALSIM II.
5. LCPSIM will provide a time series of Article 21 demands to CALSIM II, but at present it does not iterate with CALSIM II.
6. CALSIM II is central to many DWR planning studies, including the Integrated Storage Investigations.

7. CALSIM II is relied upon to compute statewide benefits and impacts of proposed projects.

8. CALSIM II is used with other models such as DSM2, agricultural land use models, economic models, and spreadsheet post-processors.

9. The CALFED process "stretched the envelope" of what can be obtained from DWRSIM and CALSIM II. A much broader set of flows and environmental parameters was required for environmental documentation than either model could provide due to their SWP and south-of-Delta focus.

10. Specific interest in using CALSIM II for Bulletin-160 is to provide a look at a greater number and range of rim hydrology sets, beyond the single average and dry year type of analysis.

11. Interest in using CALSIM II to perform high-level strategic "what-ifs" studies for future conditions, rather than detailed planning studies.

12. Would use CALSIM II with CVPM, CALAG, IWR-Main, LCPSIM, and DSM2.

13. Would like to be able to look at a range of hydrologic patterns, inter-basin water transfers, environmental regulations, and environmental flows.

14. At this point CALSIM II has not yet been chosen for the California Water Plan. This will evolve over time.

15. Post-processes CALSIM II results for a variety of project contractors and agency clients in a variety of forums and processes including environmental documentation (EIR/EIS), CALFED studies, state contractors allocation, and American River Revised Flow Standards, and Oroville FERC re-licensing.

16. Uses CALSIM II in conjunction with the water temperature and salmon mortality models and DSM2.

17. Interests relate mostly to water quality issues in the Delta, including links with the DSM2 model used in more detailed analyses.

18. The development of a seasonal CVP/SWP allocation model that uses a multiple time step optimization procedure.

19. Uses CALSIM II primarily as a planning model to compare a baseline scenario to an alternative. Looks at impacts of new facilities or different operating rules on deliveries, carryover storage, etc.

20. CALSIM II is used to provide inputs to DSM2, LCPSIM, and Russ Brown's daily Delta model for gaming purposes.

21. CALSIM II was used for prediction of water supply reliability in The State Water Project Delivery Reliability Report.

22. CALSIM II also used in Oroville FERC re-licensing in conjunction with hydrodynamics and temperature models of the Feather River.

23. To perform hydrodynamics and water quality analyses in the Delta. CALSIM II results are used as input to DSM2.
    - He uses CALSIM II for many types of planning studies including: Surface storage
    - In-Delta Storage
    - Facility, conveyance and pumping expansion
    - New diversions
    - Water transfers
    - Operating policies (both seasonal operations and operations planning)

24. Impacts of all of the above to water supply, water quality, and environment.

25. He uses CALSIM II with DSM2 for the estuary, CVGSM for groundwater, and the land use-based consumptive use model to generate hydrology.

26. He uses CALSIM II results indirectly with the CALAG model, the CVPM economics model, and the IWRMain model.

27. The main focus of CALSIM II is as a long-term planning model.

28. Currently trying to incorporate the temperature and salmon mortality models into CALSIM II.

29. Currently applications include: Shasta Enlargement, American River flow standards, CVP yield, Sites Reservoir, Los Vaqueros Enlargement, California Aqueduct-Delta Mendota Canal Intertie, conjunctive use north and south of Delta, upper San Joaquin Basin (Friant), Stanislaus River Interim Operations Plan, PEIS EIR work (trying to duplicate PEIS work with CALSIM II), and work associated with Bulleting 160.

30. Continue with development and maintenance work including: CVP allocation refinement, 2030 hydrology refinement, land use based demands on the San Joaquin River basin, improving Vernalis water quality calculations, and the implementation of hydropower accounting.

31. For agencies and districts that do no use the CALSIM II model, they (in some cases) have some small simulation models have been used.

32. Local agencies are uncertain what CALSIM II can do, mainly in terms of modeling specific watersheds. The understanding is that CALSIM II is a state model (i.e. of model of the CVP and SWP) and consequently do not know if there is a need for the model within his district. However, there is interest in possible uses of CALSIM II for watershed level applications.

33. Per the interviewee's understanding, CALSIM II is an operational model and not a projection model. It maybe be more useful to have a model that can aid in long-term planning (10-20 years from now). ."

34. For CVP OCAP, uses CALSIM II to describe current and 2020 demands, project configurations, and project operations for use in the biological assessment and ESA consultation regarding CVP and SWP operations and the South Delta process. Also uses CALSIM II for the draft EIS for the EWA and for the Phase 8 process.

35. Uses of CALSIM II include evaluation of storage, deliveries, changes in inflows and outflows, project releases, and thresholds concerning project performance. It also includes comparisons of current and future conditions and provision of input to river and temperature models.

36. Uses CALSIM II only for long-term planning and not for seasonal operations. Uses spreadsheet models for seasonal operations planning.

37. Project planning and delivery reliability analysis.

38. CALSIM II is used with DSM 2 and Particle Tracking Model to look at scour velocities, water quality impacts, fishery flows, and export capacities.

39. CALSIM II is used to perform impact assessment of proposed projects and alternative operating policies.

40. Applied CALSIM II to several projects including Shasta Enlargement, Sites Reservoir, Los Vaqueros enlargement, In-Delta Storage, California Aqueduct and Delta-Mendota Canal Intertie, Banks Capacity Enhancement, North of Delta Conjunctive Use, South of Delta Conjunctive Use, Trinity River flow alternatives, OCAP, EBMUD's Freeport diversion, etc.

41. CALSIM II is used in conjunction with USBR's water temperature and Salmon mortality models, DSM2, Fischer-Delta Model, hydropower models, groundwater models (CVGSM and IGSM), and economic models (LCPSIM, CALAG).

42. Uses CALSIM II as a planning model. To evaluate how changes in the regulatory environment, infrastructure, and hydrology would affect USBR's ability to delivery water.

43. CALSIM II has been traditionally used in a comparative mode, but there has been a shift in "philosophy" toward using CALSIM II in a predictive mode.

44. CALSIM II results are used as inputs into secondary models (ex., stream mortality, stream temperature, fish salvage models at Delta export pumps, water quality, etc.).

45. CALSIM II is used primarily as a planning model, that is, in comparative mode. Results from a benchmark study are compared to results from a perturbed study (e.g., CALFED ROD proposed projects).

46. Currently there is some call to use CALSIM II in predictive mode (e.g., CVP OCAP), but CALSIM II is not yet good enough for predictive applications.

47. Uses CALSIM II results to analyze effects of the CVPIA on project deliveries and opportunities to reduce such effects.

48. Investigations regarding improving Delta conveyance capacity associated with increasing Banks pumping capacity to 8500 cfs.

49. Examining potential integration of the CVP and SWP to find an upper bound on supply currently available to address unmet demands, considering both the current pumping capacity at Banks and an upper limit of 8500 cfs.

50. CALSIM II is the planning model of choice for USBR.

51. CALSIM II has been used in the analysis of the various CALFED ROD alternatives.

52. CALSIM II is also used for modeling operational alternatives such as the New Melones Reservoir Interim Operations Planning Review and Stockton East place of use studies.

53. Participated in global climate change study, which linked climate change model with CALSIM II, DSM 2, and APSIDE (agricultural production, salinity, irrigation, drainage, and economic model).

54. Led a team that worked on data development for an algorithm to replace the Vernalis salinity regression in CALSIM II with a more deterministic, mass balance approach to salinity computation.

55. Currently uses CALSIM II to examine surface storage projects.

56. Uses CALSIM II to evaluate impacts and benefits of In-Delta storage facility. The daily module of CALSIM II was developed for this project to accommodate the daily water quality and fisheries constraints in the Delta.

57. CALSIM II results are used as input to DSM2 to provide detailed analysis of water quality at urban intakes and for meeting requirements. Water quality violations are reduced as CALSIM II and DSM2 are simulated iteratively, often several times.

58. CALSIM II results are used for reservoir water quality modeling (Dynamic Reservoir Model) and economic models (LCPSIM)

59. Aggregated output from CALSIM II is input into CVPM (for agricultural production benefits in the Central Valley) and LCPSIM (for urban water

supply reliability benefits in the South Coast and San Francisco Bay Regions).

60. The CU (Consumptive Use) model turns the annual land use data (for the Sacramento and San Joaquin Valleys) into monthly hydrology for CALSIM II.

61. He uses CALSIM II for, ISI (Integrated Storage Investigations) studies and for the California Water Plan Update.

62. Currently the study management team is using CALSIM II (with the expanded San Joaquin representation model created by MWH and the USBR) to analyze the yield and reliability of potential surface storage projects in the Upper San Joaquin Basin.

63. CALSIM II is also being used to analyze conveyance related issues such as the availability of canal capacity to move excess flows to potential recharge areas and to help understand the effects of diversions on rivers.

64. Uses CALSIM II to evaluate proposed projects and management options to estimate their effects on available water supply and to quantify their benefits, in terms of volume of supply, timing of availability, and economic value of any changes.

65. Uses CALSIM II to support brainstorming regarding management options. Uses CALSIM II to check for significant harm from a project before further experimentation.

66. CALSIM II is new enough that a significant amount of time is spent refining the model as it is used for applications.

67. Using CALSIM II to analyze the yield, water supply reliability, and other potential benefits that can be provided by North-of-the-Delta Offstream Storage. CALSIM II is the primary analysis tool used to analyze benefits that this storage could provide.

68. CALSIM II will be used for the analyses of water supply benefits and impact for the environmental impact report/environmental impact statement for the project.

69. Other models that will be used with CALSIM II include DSM2 for analyzing Delta water quality, temperature model for the upper Sacramento River, and a number of economics models.

70. Using CALSIM II to analyze the yield, water supply reliability, and other potential benefits that can be provided by North-of-the-Delta Offstream Storage. CALSIM II is the primary analysis tool used to analyze benefits that this storage could provide.

71. CALSIM II will be used for the analyses of water supply benefits and impact for the environmental impact report/environmental impact statement for the project.

72. Other models that will be used with CALSIM II include DSM2 for analyzing Delta water quality, temperature model for the upper Sacramento River, and a number of economics models.

73. CALSIM II was designed to simulate CVP/SWP planning.

74. CALSIM II is best suited to perform what-if scenarios (i.e., in comparative mode) to evaluate impacts on CVP and SWP water supply. CALSIM II has been used to evaluate impacts of new environmental standards, export restrictions, conjunctive use, south Delta improvements, off-stream storage, changes in land use, and different water demand levels.

75. CALSIM II output is often used as input to other models such as temperature, fisheries, groundwater, and economic models. Currently, these models are not linked to CALSIM II. The current trend, however, is to link these models for better interaction and consistency. This is particularly needed for groundwater modeling

76. Uses output from CALSIM II as input for the Oroville Complex models related to FERC re-licensing of Oroville, including models of water temperature, flow-stage (HEC-RAS), and hydropower operations (HYDROPS).

77. Uses CALSIM II for seasonal planning of water operations, primarily for Monte Carlo analyses at the beginning of each water year to estimate the likelihood of filling reservoirs during that water year. CALSIM II is not an appropriate tool for every day operations planning, but is useful for "long-term" operations planning.

78. Uses CALSIM II to evaluate the likelihood that SWP deliveries will reach specific levels (using Monte Carlo analysis). SWPOCO uses an existing rule to determine the amount of stored water from Oroville that will be allocated in a given year. The current version of CALSIM II does not use the same carryover logic as SWPOCO in determining annual SWP deliveries.

79. Uses CALSIM II for various planning purposes, including:
    - to evaluate the sensitivity of SWP performance to near-term storage levels, and
    - to provide boundary conditions for detailed local analyses, such as FERC re-licensing of Oroville.

80. Uses CALSIM II for seasonal planning of water operations, primarily for Monte Carlo analyses at the beginning of each water year to estimate the likelihood of filling reservoirs during that water year. CALSIM II is not an appropriate tool for every day operations planning, but is useful for "long-term" operations planning.

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82. Uses CALSIM II for various planning purposes, including: to evaluate the sensitivity of SWP performance to near-term storage levels, and to provide boundary conditions for detailed local analyses, such as FERC re-licensing of Oroville.

83. CALSIM II is used mainly for statewide planning studies of CVP/SWP, and for different interest groups. For example: SWRCB Bay Delta hearings, SWP contractors (e.g., Oroville FERC re-licensing), CALFED, EPA, and others.

84. CALSIM II (and its predecessors) has been used with the CVGSM, CVPM, Depletion Model, Consumptive Use Model, and other regional models.

85. Uses other resource simulation models to analyze supply reliability, and the need for supplemental water supply (e.g., transfers), local supplies (e.g., groundwater, recycled water, or desalinization), and integration of local supplies and imported water for regional planning purposes.

86. Uses other resource simulation models as the basis for its Integrated Resources Plan. This includes evaluating justifications for facility size, siting, and issues associated with EIRs; evaluating potential conjunctive use projects; and determining need for water from import supply sources, including related programs such as land fallowing programs.

87. Uses output from CALSIM II for input to its sequentially indexed Monte Carlo simulations. In this approach, the user modifies its models to reflect the anticipated sequence of events associated with the development of the project or facility in question, and then applies a run of the historical hydrology to all components of the system that the models capture.

88. User uses CALSIM II to model water quality in the Delta.

89. Intends to use a Stanislaus River stand alone version of CALSIM II to develop a revised operations plan for the Stanislaus River, to try to determine how much water can be provided for environmental purposes given prior water rights, existing environmental flows, and project obligations.

90. CALSIM II will be used to perform biological assessments and assess potential impacts of proposed projects/modified hydrology and operations such as the Freeport Project, increased level of development, 8,500cfs of pumping capacity at Banks, and Trinity operations.

91. Because CALSIM II is the only tool that can be used for long-term analysis, uses of CALSIM II include:

- o Review of runs that have been made for environmental impact reports to determine if model runs reasonably portray project operations.
- o Review of OCAP to assess new criteria, educate the public, and generate discussion between agencies regarding the trade-offs and water supply impacts.
- o Review effectiveness of environmental goals.

92. ESA consultation and COA analysis.

93. CALSIM II is used in conjunction with Reclamation's water temperature and fish mortality models to evaluate impacts to fisheries.

94. Improvements to Delta operation rules.

3) Do you anticipate additional future uses of CALSIM II? What might they be and would they require interaction with other models or analytical tools?

1. CALSIM II will most likely be used for the SWRCB's triennial review. Outputs from CALSIM II would be used as inputs into the Suisun Marsh models. The marsh models would be used to determine the impacts on the Marsh from changes in the required Delta water quality standards.

2. Current hydrodynamic models have moved to a finer-scale (both in terms of time and space). CALSIM II is a monthly model, so its applicability is limited to analysis of long-term trends or coarse frequency analysis. This is valuable capability.

3. CALSIM II can be used to look at the benefits and impacts of water use efficiency changes, once agricultural and urban water use and spatial detail have been refined.

4. CALSIM II will be used to look at the benefits of water transfers.

5. MWD is implementing water quality (i.e., source and transport of conservative constituents) into CALSIM II. A second stage will add water quality objectives to the LP objective function.

6. Eventually pass data between CALSIM II and CVGSM for modeling groundwater.

7. Increased interaction with CALAG and IWRMAIN.

8. CALSIM II will be used for helping make SWP project allocation decisions using a seasonal multi-period optimization module based on forecasted inflow

9. CALSIM II will be used for a myriad of potential projects for surface and groundwater storage, to provide cumulative impact assessment of projects individually or their combinations.

10. Because of growing need to quantify the benefits of CALFED programs, CALSIM II will be used to assess benefits achievable by projects, especially for groundwater projects.

11. For Bulletin-160 phases 2 and 3, may use CALSIM II as one of the tools available for examining performance of management strategies for different scenarios.

12. CALSIM II is a good stepping-stone, as it embodies DWR and USBR knowledge of the system.

13. Due to stakeholder interest, would like to have CALSIM II interact with other models, such as economic, agricultural production and water quality models.

14. We are stuck with CALSIM II. In house we use PROSIM for the job and perform the final runs with CALSIM II. The differences between the two models are small.

15. Implementation of multi-step optimization in CALSIM II to better mimic operations decisions.

16. Would like to see a common model for operations and planning that would replace the operations group spreadsheet model and add optimization and position analysis.

17. Re-evaluation of B2 modeling.

18. CALSIM II linkage with groundwater modeling to improve the representation of surface and groundwater interactions.

19. Link CALSIM II with water quality models and water temperature models.

20. Link CALSIM II with other tools so that interactions in gaming exercises are easier.

21. Input data is being entered into a relational database. This input database will include data documentation and will allow greater input control.

22. As in 2).

23. He would like to see the model expanded for use in real-time operations, including forecasting tools and probability-based operating rules. This would require a shorter time step.

24. He would like to add water quality to CALSIM II.

25. He would like to add short-term optimization so that CALSIM II can be used for operations simulation and optimization.

26. His group has been dissecting the SWP operations spreadsheet model to better understand and represent operators' decisions. This would also increase the credibility of the model.

27. The philosophy in developing CALSIM II has been to develop:

28. A common language that all water resources people in California can use.

29. A model that is public domain and free of charge.

30. A user interface that is easy to use.

31. He would like to see CALSIM II as a model that local entities can use as a primary planning tool, so that there is more sharing of information and data. This will result in reduced disputes over scientific facts.

32. CALSIM II will continue to be used in planning studies.

33. Currently consulting with CVP/SWP operators to better reflect real-time project operations in CALSIM II.

34. CALSIM II is likely to be used as a basis for economic analysis.

35. Agencies or districts that do not currently use CALSIM II think it is possible that in the future they could use CALSIM II in conjunction with other existing models for long-term planning applications.

36. Yes - CALSIM II is the "tool of choice" as a fully-developed representation of the CVP and SWP. Any significant new project or change in operations likely will be analyzed using CALSIM II.

37. Plans to use CALSIM II to perform climate change studies.

38. Would like to develop an improved way to use CALSIM II to analyze delivery reliability, perhaps more like MWD's Monte Carlo runs to capture the potential variability in hydrologic series and reservoir storages.

39. Hopes CALSIM II peer review will help gain stakeholder confidence.

40. Will continue to use CALSIM II for impact analysis.

41. Future uses might include the evaluation of water transfers.

42. Likely to couple CALSIM II with other tools to evaluate the possibility of water transfers, to better represent surface and groundwater interactions, and with GIS for better result presentation.

43. Likely to implement water quality blending calculations.

44. CALSIM II will continue to be used in comparative and predictive studies.

45. Would like to use CALSIM II to help derive M&I shortage criteria. The difficulty here is that M&I demands might be too small to make a difference in CALSIM II.

46. Another use of CALSIM II that is in the "dream stage" is to determine south of Delta allocation. This would require a more detailed modeling of the south of Delta agriculture demands, and to develop a probability distribution for demands and Tracy pumping. The use of Monte Carlo analysis would give managers a better idea for risk in allocation.

47. Development of a daily model for the American River in CALSIM II is currently underway.

48. Will continue to use CALSIM II to evaluate potential projects and operations, including efforts to reduce the effects of the CVPIA on supply and to support integrated CVP/SWP operations planning.

49. CALSIM II will be used for all USBR planning studies.

50. As allocation logic is improved in CALSIM II it might also be used as the model of choice for CVP operations.

51. Has promoted the application of CALSIM for the Klamath Basin to replace an inadequate existing model.

52. Currently jointly funded with LBNL computer science to replace the CALSIM II XA solver with a public domain solver. DWR and USBR have promised staff to work with LBL computer scientist(s) on the implementation of the new solver.

53. Will continue CALSIM II use for climate change studies to examine the seasonal shifting of flows and sea level rise.

54. He expects to continue using CALSIM II as discussed above and does not anticipate any changes in use in the future.

55. CALSIM II output will be used in conjunction with other economic models as the basis for cost/benefit analyses.

56. Analyses of the effects (together, separately and/or in some combination) of the five proposed CALFED storage projects (Shasta Enlargement, North of Delta, In-Delta, Los Vaqueros Enlargement and South of Delta) will be done using CALSIM II.

57. CALSIM II might also be applied to hydropower generation, though this may be done as a post-processing (i.e., spreadsheet) activity.

58. Currently conjunctive use is analyzed using a post-processor (spreadsheet model). Eventually CALSIM II might be used to look at the overall water

supply in the San Joaquin River, once groundwater interactions are better represented.

59. A weekly or daily time step, especially for the Delta and Sacramento Valley operations, would allow them to model temperature management activities and to use CALSIM II more as an operations tool.

60. Many new activities that they would like to model require a time step of less than one month.

61. Will continue to use CALSIM II for EIR/EIS.

62. CALSIM II will eventually be a daily time step model that may be used with other operations tool to guide the operations of North-of-the-Delta Offstream Storage after the reservoir is constructed.

63. See 2)c.

64. As resources become scarcer and conflicts develop, more questions can be answered with modeling. Increasingly, those in management position need modeling study results to answer policy questions and back up policy decisions. "The future is full of modeling". However, we have to make sure that people understand the limitations of the tools used.

65. Use of CALSIM II and position analysis for real-time operations.

66. Geographical expansion of CALSIM II to encompass other areas of the State (e.g., southern California), and to include a better representation of surface and groundwater interactions.

67. Because CVP and SWP operations are largely driven by regulatory requirements, a smaller time step will be needed in the near future to improve the credibility of CALSIM II.

68. There is a need for a model with a common database that is standard for multiple users.

69. If delivery logic is made consistent with that used in Operations, CALSIM II could be used to better integrate long-term and short-term operations, including multi-year operations.

70. Would like to use output from CALSIM II for seasonal, operational planning for energy production, particularly the effects of SWP deliveries on energy production. This would allow the SWPOCO to better plan its energy market strategy.

71. Validation of shorter-term models to ensure that DWR does not over- or under-commit water to contractors. In order for CALSIM II to serve as a validation tool, its synthetic hydrology must be adjusted to reflect short-term

Snow Survey hydrology forecasts, which are used by the short-term operation spreadsheet model.

72. CALSIM II simulates operating decisions; eventually it should be flexible enough to test different operating rules and improve operating rules and guidelines. This would require modifications to the rule module.

73. As CALSIM II's representation of the SWP system improves, it is anticipated that CALSIM II would be used more often in an "absolute" rather than a comparative mode. Most of the internal analyses performed by the SWPOCO use modeling results in the “absolute” mode, but planners and operators would like to have more confidence in the model's predictions.

74. As operational complexity increases and flexibility decreases, operations will have to be less conservative and operators probably will rely upon analytical tools to assess the associated risks.

75. Enhancements to surface water/groundwater interaction and groundwater representation in CALSIM II. Integration of IGSM2 and CALSIM II.

76. CALSIM II will continue to be used for SWP and CVP analyses and other projects (e.g., the Upper American River Basin, the Yuba River Basin, and the Bear River Basin).

77. Next version of CALSIM II will have the Upper American River, the Yuba, Bear, and the Stony Creek systems integrated directly with CALSIM II.

78. At some point in the future, the Tulare Basin may also be included, as it is a critically important area for balancing of supplies and demands in the Central Valley.

79. CALSIM II provides boundary flow conditions for the Delta flow/salinity model DSM2.

80. Will continue to use CALSIM II as a major part of its reliability, planning, and implementation studies.

81. Anticipates an increase in its use of CALSIM II with the implementation of the CALFED ROD.

82. Anticipates additional future use of CALSIM II in modeling water quality in the Delta.

83. Will use CALSIM II to develop its resource and legal strategies relating to use of water from the Colorado River. User will use CALSIM II as part of its assessment of the quantity of water it needs from the river to remain reliable.

84. CALSIM II will be used to perform Monte Carlo type analysis once correctly implemented.

85. Conjunctive use studies.

86. Items listed under question 2).

4) From your own experience, what specific aspects of the CALSIM II model do you feel are particularly strong or weak? Why? Please detail each concern (concerns can include, but are not limited to, input data, model formulation, model calibration, software, user guidance, surface hydrology, groundwater, water demands, operating rules, etc.) and provide relevant references.

1. CALSIM II (and DWRSIM) does not do routing. For river systems and estuaries the lag time response is very important. For example the 5-day Shasta to Delta flow period is roughly the same length of the spring neap cycle. However, for incremental analysis the notion of routing and lags are of less importance, since they would already be "lumped" in with the other errors.

2. CALSIM II has problems modeling carriage water. There have been instances where the ANN (trained on DSM2) has reported negative carriage water.

3. Many have wondered why CALSIM II does not include a scaled down physical model of the Delta (ex., a coarse grid DSM2). It would need to capture the most important non-linear relationships. Addition of a physically-based model would reduce or avoid the need to recalibrate Delta salinity relationships with changes in Delta operations, South of Delta seasonal barriers, changes in pumping locations, etc.

4. Land use data from CVPM is used to develop demands for CALSIM II. There should be iteration between CALSIM II and CVPM, but this has not being done in the past. There are also concerns regarding the validity of CVPM and its successor, CALAG, which affect the validity of CALSIM II.

5. Local hydrologic assumptions for CVPM and CALSIM II do not always agree. This problem is being addressed presently.

6. It is sometime very difficult to determine if the model is acting appropriately, and if not, why not. CALSIM II is a mix of constraints and priorities. There is a lack of post-processors to aid in interpreting results and correcting errors

7. Setting the weights in CALSIM II LP objective can be a problem (. There is no standard rigorous method to set the weights.

8. The solver can produce non-unique solutions. Theoretically inconsequential changes in the formulation can change the solution by bouncing between equally penalized corner points.

9. Small changes in the system can cause big changes in output solutions, due to thresholds (e.g. streamflows) that act as triggers for environmental actions.

10. WRESL was designed to make CALSIM modeling more transparent, but the model requires hundreds of input files. This has frustrated and inhibited many potential users and given people on the "outside" the impression that CALSIM modeling is a "closed shop".

11. CALSIM II has poor documentation, but this is being worked on.

12. CALSIM II has very poor version control. There are no descriptions of the changes made to the model between versions. Currently DWR is using CSDIFF to track version differences, but it is only a line-by-line text comparison program.

13. CALSIM II does not have a stable base case or benchmark. The original plan was to have a benchmark study that would be in-place and unchanged for a set period of time and then have users perform their studies using a common model. This did not occur.

14. CALSIM II is so big a model that no one person understands it all. The staff structure in DWR leads to specialization, where individuals know one portion of the model very well, but do not necessarily understand other parts of the model.

15. There is no centralized location where the calculation files are stored (i.e., no centralized archive for detailed background documentation and calculations).

16. CALSIM II is good at representing the institutional and regulatory constraints.

17. CALSIM II is a joint USBR/DWR model, which is a strength.

18. There has been a lack of work on the hydrology underlying the model. Hydrology problems include:

19. Demands, efficiencies, reuse, and losses are based on 1970's studies. The data is out of date.

20. No good handle on groundwater pumping.

21. Forecasting methodology is different from that used by DWR's Office of Flood Management.

22. Poor project/Non-Project splitting of land-use based demands.

23. Poor representation of local supplies (e.g., smaller unregulated supplies and the location of their return flows).

24. CALSIM II lacks representation of indoor non-consumptive use and local water sources for M&I demands.

25. There is poor water quality representation on the San Joaquin River in CALSIM II.

26. The Sacramento Valley is modeled at too aggregated a scale in CALSIM II. It fails to capture the diversity of demands and supply rights. (But there is some work ongoing in this area to move to the irrigation district level.)

27. There are no economics in CALSIM II.

28. Presently water transfers must be individually pre-specified (i.e., not economically driven

29. One of the greatest weaknesses of CALSIM II and its predecessors is institutional, from the origin CALSIM II as a model of the CVP and SWP systems. This original purpose has limited the use of CALSIM II and made its use for overall management of California water resources difficult. This origin also creates the perception that CALSIM II appears slanted toward CVP and SWP. For instance, CALSIM II is not well suited to look at changes in rim hydrology.

30. One of the greatest weaknesses for DWRSIM was its sensitivity to slight tweaks in parameters (e.g., carryover storage rule curve). Such sensitivity resulted in difficulty in carrying out realistic comparison of alternatives.

31. For DWRSIM, many parameters were quantified very subjectively.

32. CALSIM II was developed as a joint CVP-SWP model, but its application has stretched far beyond these concerns.

33. CALSIM II cannot be used to analyze impacts resulting from fishery and operational constraints due to its long time step.

34. CALSIM II is the "best we have" for this very complex and controversial system.

35. During the CALFED process, there was shock and disappointment when we realized that despite the considerable investment in water use efficiency, the modeled water demand remained based on contract amount. The way the model was applied was of great concern to CALFED stakeholders. Unsure whether this is a shortcoming of the model or of the way it is being applied.

36. The development of alternative hydrology input data sets appears to be a clumsy process, including finding errors in the hydrology that resulted in considerable changes in model output.

37. One of the greatest strengths of CALSIM II is its transparency in terms of model accessibility, data, and assumptions.

38. The formation of an informal users group is positive.

39. The software and numerics are strong.

40. The users' guide is useful to teach people how to use the model. However, an applications guide is needed.

41. No other tool comes close to CALSIM II detailed representation of operating rules.

42. The 80-year hydrology provides a wide range of hydrologic impulses.

43. The initial benchmark study was not good, but has improved over time. It is difficult, however, to work on long-term projects such as the EWA analysis when the Benchmark study and CALSIM II are always changing. It is hard to keep up with model revisions.

44. DWR is often defensive. The defensive style is part of the problem.

45. EWA representation is poor, but it is very hard, if not impossible to model the EWA. Rather than run the EWA layer of CALSIM II, prefers to perform the EWA analysis manually.

46. There are problems with water allocation algorithms. Long-term deliveries are fine, but they are very bad in spots. When comparing CALSIM II and PROSIM, the delivery frequency curves are very similar.

47. CALSIM II engine is not bad.

48. The ANN is going to be good, but it is not there yet.

49. The hydrology changes that have been made are good.

50. CALSIM II is harder to use than previous models. Perhaps that is a problem that will be overcome with time.

51. The Yuba River hydrology is a problem. There are also other data problems that are being worked on, but it will take time to get all these problems fixed.

52. There is very little in terms of user guidance and model documentation. For instance, what is labeled as Delta surplus is not really Delta surplus (there is no documentation to let the model user know that). Delta surplus has to be calculated from other model outputs.

53. Many of the problems have been around for a while. For instance, San Luis operations require post-processing. This has been a problem for over 20 years and was carried over from previous models to CALSIM II. CALSIM II operations need to be more appropriate.

54. The model is fine now for delivery reliability estimation.

55. Flexible, highly modifiable. CALSIM is well equipped to tackle almost any Water Resources planning scenarios that deal with larger scale, long-term planning horizons. May be the only tool available that can model California's complex water issues dynamically on a statewide scale.

56. The strongest aspect of CALISM II is perhaps also one of its weakest features. While CALSIM II can be easily modified to simulate almost anything, there are dangers associated with this flexibility. Because it is easy to make changes to CALSIM II, changes can be made at a very fast rate and thus can be difficult to track. It takes considerable scrutiny and review when changes are made to CALSIM II.

57. CALSIM II is almost growing too fast for outsiders to keep up. It can be hard to keep up with what is going on in the model. While there were only one or two people involved in the development of DWRSIM, there are now many more people involved in the development of CALSIM II, both within and outside the agencies. A version-control software is currently being used to track changes to the model.

58. Documentation of code and input data has been weak because it was based on DWRSIM that had some weak documentation of input data and operational rules. The CALSIM II documentation group is currently working to improve documentation.

59. CALSIM II is a complex model that simulates a complex system. The learning curve for anyone using CALSIM II is steep, as it requires a significant amount of time and patience to interpret its results. It may take hours or days to find the root of flawed operation if one does not possess a good understanding of LP.

60. The hydrologic data is weak in certain areas. There is not enough information on groundwater parameters, basin efficiencies (which affect the calculation of return flows), etc. This however is common to any model or tool that uses average basin-wide parameters such as efficiencies and hydraulic conductivities. Some data is outdated and does not reflect current practices such as the flooding of rice fields.

61. An updated ANN currently under development is an improvement for representing Delta flow-salinity relationship.

62. CALSIM II model does not appear to be algorithmic. To produce an acceptable CALSIM II run, intermediate model results are viewed and model parameters are adjusted until the desired result is reached. This process involves significant amount of human input, and independent investigators working from the same starting point will not produce the same output. The sensitivity/leeway in results to this type of manipulation should be quantified and compared to the differences between alternatives in the same study. At the same time the formulation should be made more robust so that the solution does not depend on intermediate user input – therefore avoiding the potential criticism that the solution has been "guided" towards a desirable outcome.

63. Some sub-components of CALSIM simulations reflect systems where hourly or daily dynamics have an important bearing on decisions. When these are

applied in a monthly CALSIM model, the effects of these decisions must be aggregated to monthly time steps. Take, for instance, the question "what is the highest monthly pumping value allowed while fulfilling a stage constraint in the south delta". Such a constraint will be active only for a few moments each month. In the field, operators will briefly cut pumping or flatten their electricity-based schedule until the monthly low tide is passed and then resume pumping normally a day later. This short-term adjustment barely makes a dent in terms of monthly average, and a good method of aggregations would reflect this. In contrast, CALSIM and its supporting DSM2 runs assume a "flat-line" whereby the flow during the entire month must be the same as the critical stage moment. Under such a restriction, a few hours' worth of problems may cause an entire month of pumping reduced by 50%. This does not mean that the monthly time step is inadequate for CALSIM, but rather that small-time-scale decisions must be aggregated more thoughtfully into monthly costs. In fact, daily hydrology may exacerbate this problem, since it is usually drawn and scaled from historical records and thus will not usually have a crisis in exactly the same part of the month as the scenario at hand.

64. Water quality objectives in the Delta can be met by a variety of release/export schedules over time. There are significant differences in the water cost and water quality resulting from these patterns, and the scheduling strategies used by operators have both a short-term (spring-neap, wind) component and a long-term memory component. Depending on the focus of the CALSIM study, release and pumping schedules should be either 1) typical or 2) optimized. Instead, flow patterns are neither optimized over time nor do they necessarily account for typical operator behavior and expertise. This may underestimate operator's abilities to meet water quality objectives.

65. CALSIM II should either have a well-defined salinity carryover penalty or implement some form of look-ahead and rules-of-thumb reflecting real-time operator decisions.

66. One of the contributions of CALSIM II to California water is its open architecture and data structure. It makes both data and operations potentially transparent to all.

67. One of the strengths of CALSIM II is its state-of-the-art engine.

68. CALSIM II is data-driven.

69. The GNU public license requires that modifications to the model software become public domain.

70. CALSIM II still has a long way to go technically.

71. A shorter time step would be better for many purposes. A daily time step would better capture hydrologic variance and better represent the estuary, reservoir operations, and river temperature.

72. Groundwater representation and aquifer interactions must be improved

73. Statewide coverage is needed, particularly the Tulare Basin.

74. Data gaps for hydrology need to be addressed. Streamflow data and groundwater data are needed for calibration of groundwater models.

75. One of the contributions of CALSIM II to California water is its open architecture and data structure. It makes both data and operations potentially transparent to all.

76. One of the strengths of CALSIM II is its state-of-the-art engine.

77. CALSIM II is data-driven.

78. The GNU public license requires that modifications to the model software become public domain.

79. CALSIM II still has a long way to go technically.

80. A shorter time step would be better for many purposes. A daily time step would better capture hydrologic variance and better represent the estuary, reservoir operations, and river temperature.

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91. Statewide coverage is needed, particularly the Tulare Basin.

92. Data gaps for hydrology need to be addressed. Streamflow data and groundwater data are needed for calibration of groundwater models.

93. CALSIM II is the most comprehensive analytical tool available describing the CVP and SWP system, including the layered regulatory requirements (D-1485, D-1641, B2, and EWA).

94. CALSIM II is the model with the most extensive geographical coverage.

95. CALSIM II is the common model for DWR and USBR for comparative analyses.

96. CALSIM II is easier to modify than PROSIM or DWRSIM.

97. The modularity that comes from using a solver is a good improvement from PROSIM.

98. CALSIM II lacks comprehensive documentation for methodology, inputs, and model logic.

99. CALSIM II lacks documentation on sensitivity of model parameters.

100. There are several errors in the GUI. Tables and charts do not always display output data. GUI has limited graphical capabilities.

101. There are no visual tools for the schematic.

102. It is difficult to understand and interpret CALSIM II results. There is no tool to easily visualize simulation results and obtain answers to common questions.

103. The weight structure is difficult to establish, as it is not purely hierarchical. More study is needed to determine best way to set up the weight structure.

104. XA solver does not provide enough information such as which constraints are binding, etc.

105. CALSIM II is an operations model for current situations, mainly focusing on the SWP and CVP systems. The model could have more potential for use if it were simplified to be used at the watershed level.

106. CALSIM II's ability to reproduce time series and sequences of operations is a strength.

107. The level of detail in the inputs (e.g., hydrology, demands) for CALSIM II is an improvement over past models.

108. CALSIM II's level of detail provides capabilities to look at changes to the system that no other model can evaluate.

109. Any single year's results may conflict with what operations staff would produce for that year using their operations forecast. The timing and size of

releases and allocations in some areas depart from conventional wisdom of operations given the conditions. CALSIM II does not always simulate the best operations in that one year, but rather provides an approximation of actual operations, which are better informed and more thorough. This is important to keep in mind when interpreting results.

110. CALSIM II's allocations of storage in response to hydrologic conditions are particularly different from real operations. CALSIM II holds and releases water counter to what operators would do.

111. The simulation of the allocation process needs work. It is a challenge to mimic what is done in practice, since in reality, allocation is the "final result" of many considerations. The declaration of water supply available to contractors is updated monthly (in both CALSIM II and reality). CALSIM II's final allocations "don't look quite right" given hydrologic conditions.

112. Has some reservations about CALSIM II's size and resource requirements (both computer and especially human). "It's a monster" and he wishes he knew the model better.

113. CALSIM II cannot meet all modeling needs. It should serve its niche well, rather than all purposes. You should not use more model than you need for a given project. For example, CALSIM II is not perfect for CVP OCAP, but there is no better model available.

114. The existence of CALSIM II as a single, unified model supported by an interagency team is a good thing. The lack of a common modeling tool caused difficulties in the past.

115. The groundwater representation in CALSIM II could be improved.

116. CALSIM II in predictive mode is weaker than in comparative mode.

117. DWR has done a good job in CALSIM II training and public outreach. Although this is not the primary focus, it is important for moving plans forward.

118. CALSIM II surface hydrology is good.

119. Operations rules are good except for EWA. Would like to have an assessment of functionality of EWA (actual performance) as well as representation of EWA in CALSIM II.

120. "Everything is weak." The foundation data (hydrology and allocation rules) are weak. Errors in the hydrology are propagated through each layer of the model. The major weakness in CALSIM II is in basic information. The hydrology, although much improved from its predecessors, is still very coarse. Improvements are needed on rim flows, M&I accounting, farm level processes (deep percolation and return flows), etc.

121. CALSIM II is the best model so far in terms of its capabilities. However, we do not necessarily get a better product from it, as much effort is still needed on basic input data.

122. There is no lead person for CALSIM II who shepherds all CALSIM II efforts. There is no central location where development information is kept. This has been the source of many of the problems with CALSIM II.

123. CALSIM II developers have not established a protocol to document model changes. A revision control system is currently being implemented, but the process has been slow.

124. CALSIM II does a good job of detailing operating policies and environmental regulations. This strength is also a weakness, as it is almost impossible for a layperson to understand model results.

125. CALSIM II is very far from the original vision and expectation that it would be accessible to everyone.

126. The allocation logic in CALSIM II is very crude and empirical. This is currently being addressed in efforts to make CALSIM II better reflect real-time decisions of operators.

127. Monthly representation of Delta operations is another weakness of CALSIM II.

128. The water costs generated by the ANN are too high. It does not mimic DSM2 very well.

129. CALSIM II utility is in comparative mode. It cannot answer absolute mode questions.

130. Assessment of impacts to fisheries is way beyond the capability of CALSIM II. Nonetheless, CALSIM II has to be used for EIR/EIS impact analysis.

131. South of Delta demands needs improvement.

132. The representation of the Feather River operations is outdated.

133. The Upper American River is not well represented.

134. D-1644 on the Yuba River has been implemented in CALSIM II. That is strength when compared with previous models.

135. There are multiple optima in CALSIM II. Solutions are not unique. A small perturbation in input can result in considerable changes in results.

136. It is still not clear exactly which parameters CALSIM II is highly sensitive to.

137. The software is limited. It is hard to debug CALSIM II, as the solver does not provide details of LP solution.

138. CALSIM II is cumbersome to use.

139. There is no capability to re-run a single time step of the LP.

140. CALSIM II formulation is based on DWRSIM formulation. Not much thought was put into developing a model that could answer the questions that face the system.

141. Current representation of (b)(2) is good.

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163. Current representation of (b)(2) is good.

164. Input data management is weak. The input data tables are cumbersome. The input files are fixed format text files, rather than in some type of database.

165. Have not read anything supporting the rational for using a mixed integer linear programming solver, not that there's anything wrong with using this solver. There is a general lack of solver documentation. Some type of documentation listing the pros and cons of other solvers would be valuable.

166. Infeasibilities are difficult to correct. It takes considerable experience and time to identify the causes of the infeasibility. The lack of documentation makes it difficult to handle infeasibilities.

167. The modeling of the EWA is weak, but it is now getting increased attention by Reclamation and DWR – improvements are expected in coming months.

168. CALSIM II is an imprecise model, which is acceptable for comparative studies, but may not be for predictive models.

169. One strength of CALSIM II is that it is somewhat easy to trace the code, making the software for the model and the application of CALSIM II more widely understood than its predecessor models.

170. Another strength of CALSIM II is that it is a common planning model used by federal and state agencies. The agencies are now arguing about results, rather than assumptions of how each other's systems are represented in their own planning models (e.g. DWRSIM and PROSIM models as predecessors to CALSIM II).

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178. The modeling of demands in CALSIM II needs to be improved. Demands should be based on user behavior rather than contractual amounts.

179. Groundwater representation in CALSIM II is very primitive. Groundwater and surface water interactions need to be better represented.

180. Additional water quality stations should be added in the ANN or G-Model.

181. For reservoirs that have upstream regulation, upstream reservoirs should be incorporated in CALSIM II (e.g., upper American River).

182. For several types of analyses, a smaller time step would be necessary to capture the full effect of hydrologic variability (e.g., Sites Reservoir).

183. The greatest strength of CALSIM II is that it is a single model, used by both agencies. We no longer need to waste time arguing (model wars) over which model is right.

184. It has been a wonderful experience to work with DWR on CALSIM II. CALSIM II has promoted much positive interaction between the agencies, which allows for progress to be made much more rapidly.

185. DWR and USBR's "coequal" roles and stakes in CALSIM II give the agencies a common tool and "language," which helps in the effort to explore new and different ideas and to assemble support and buy-in for them.

186. It is good that CALSIM II is publicly available.

187. CALSIM II simplifies operations and details of the system to encompass both water projects. While CALSIM II is a comparative model, it should still provide the best representation possible.

188. A daily time step would be an improvement.

189. Demand patterns and representation of the EWA need refinement.

190. CALSIM II is still so new that there are not enough experienced users, although this number is growing.

191. Likes the concept of the tool very much. Sees potential for applying CALSIM software to other basins.

192. Software weaknesses:

193. It is hard to debug, especially for infeasibilities. It can take many days to find the source of a problem.

194. WRESL code documentation is "hit or miss". Portions of it are well documented while others are not.

195. Software strengths:

196. All input data is in common format (either table or DSS). It is relatively easy to understand the data.

197. CALSIM II WRESL code is very clear. Was able to understand system functionality and learn the system from reading the WRESL code. Learned (b)(2) and Stanislaus River logic from the WRESL code. Does not think that the WRESL code is much more complex than PROSIM code.

198. Believes that model users must take time to read code to use the model. CALSIM II is unique in that it is the first water allocation model that both state and federal agencies have agreed on. "CALSIM II is a critically important model."

199. Groundwater and water quality are inadequately simulated in CALSIM II. A strong coupling with groundwater and water quality models is needed.

200. Current computation of salinity at Vernalis is weak and should be replaced with a more deterministic algorithm (see 3b and 5c).
201. CALSIM II is becoming rather complicated, with only a small pool of people that understand the model enough to make changes. We are going back to the same problem that we had with PROSIM and DWRSIM, where only very few people were proficient enough to work with the model.
202. Some processes are difficult to model, such as criteria for Delta Smelt presence at the pumping plant that require that pump operations be stopped (D-1643).
203. Similarly with EWA. There is very little information/ experience to model EWA. Current modeling of EWA is mostly based on assumptions.
204. Short-term decisions are hard to represent and there is little experience representing them.
205. Commercial competition between consulting firms that work with CALSIM II provides disincentives for them to be forthcoming with information about and assistance with the model. Ability to use CALSIM II has become somewhat proprietary knowledge held by a few competing firms. This has restricted the flow of insight regarding CALSIM II to other parties.
206. CALSIM II is now more of a land-use based model, an improvement over previous models that were not as extensively land-use based.
207. Groundwater representation and integration is being improved.
208. Early on, DWRSIM tried to meet the same target deliveries each year. Later, the target deliveries were adjusted for climate variability. CALSIM II now iterates with MWD's IRPSIM so annual delivery targets better represent local demands. The demand variability is less of a concern for agricultural deliveries, since most farmers will use available SWP/CVP deliveries to replace pumped groundwater.
209. Work has been started to investigate iterating target deliveries with demands using LCPSIM.
210. CALSIM II has the ability to simulate the operations (for planning purposes) of the complex rules governing the statewide operations of the SWP and CVP systems.
211. CALSIM II is a jointly developed model, making it the "obvious" choice for the CALFED analyses.
212. "A model is never done." Given that, CALSIM II needs better representation of some systems operations, such as EWA, and (b)(2), which recently have been better clarified in courts.
213. CALSIM II needs better modeling of water quality issues.
214. A daily simulation capability is needed for analysis of Delta facilities (e.g., Delta Wetlands Project).

215. CALSIM II is a good model for planning (i.e., comparative mode) studies and analyses.

216. The number of experienced users of CALSIM II is very small. Although it will take time to expand this group, it will be increasingly important to do so as the volume of work requiring CALSIM II runs increases.

217. It is very good that USBR and DWR are working together on CALSIM II. The cooperation provides a huge benefit and has moved both agencies forward.

218. CALSIM II has created a spirit of cooperation and joint ownership of the model, which is beneficial to everyone.

219. CALSIM II is more transparent and versatile than PROSIM was.

220. CALSIM II is a tool that can be built upon and serve as a framework for future work.

221. There is a continuing effort to document CALSIM II. This will help future users to build on CALSIM II.

222. It would not have been possible to model (b)(2) accounting or EWA water using the older models. CALSIM II has already surpassed their capabilities.

223. Groundwater aquifers should be represented better.

224. CALSIM II should include the Tulare Basin.

225. The depiction of salinity in the Delta needs improvement. The ANN should improve results. There has been good collaboration between USBR, DWR, Contra Costa WD, MWD, and others on this area of work.

226. A daily time step is needed for Delta operations.

227. CALSIM II's can simulate the operation (for planning purposes) of the complex rules governing the statewide operation of the SWP and CVP systems fairly well.

228. The WRESL code is easy to understand and change. The WRESL code in CALSIM II allows the user the ability to change the model code rather easily. It makes CALSIM II very flexible.

229. One of the weaknesses of CALSIM II is the monthly time step. A monthly time step cannot accurately model some daily or weekly time step regulatory standards .

230. Another weakness is that CALSIM II is not calibrated. Results do not necessarily match historic operations. This is not a problem as long as CALSIM II is used for comparative analyses only.

231. Groundwater/Surface water interactions are not being modeled as explicitly as it should be.

232. The CALSIM II calibration/verification is a weakness. It is important to let people know that the limitations of CALSIM II and that planning models cannot be calibrated/verified in the same way as physical models.

233. Some of the input data needs improvement. There is a fair amount of geographic lumping of data in CALISM II. A finer geographic resolution is needed, but it is important that consistent data is used.

234. The time step should be reduced.

235. Some aspects of real-time operations are not easily implemented in a planning model. This is especially true of temperature and biological objectives.

236. A better representation of stream-aquifer interactions is needed in CALISM II.

237. CALSIM II users need more guidance. Public agencies are generally not geared to provide training like private software developers.

238. Expectations of CALSIM II are too high. CALSIM II is a model of the CVP/SWP, not a statewide planning model.

239. The rainfall-runoff simulations for small catchments are poor. They are based on empirical relations that are somewhat weak. Good information on a smaller geographical and time-scales is not available.

240. CALISM II is a good tool to perform what-if scenarios at a system-wide scale and to evaluate effects throughout the system.

241. CALISM II uses adjusted historical flows, which is easier for the public to understand.

242. CALSIM II can be run very quickly.

243. CALSIM II data is all in the users' hands and not hidden in the code. Any user can create the input files very quickly.

244. CALSIM II is easier to change and work with than DWRSIM. If CALSIM II and DWRSIM were lined up to run identical studies, CALISIM II would be easier and faster to set up and run than DWRSIM. Much of DWRSIM data and assumptions had to be put into the code.

245. Parties interested in modeling the CVP/SWP system have a common tool with which to work. This is a big achievement.

246. The LP engine is a more efficient code than DWRSIM's procedural code.

247. The CALSIM II group could use more staff to work on integrating land use and changes in a more transparent way, such as using GIS linkages.

248. A smaller time step is important for many projects.

249. A more detailed representation of the Delta is needed, particularly in relation to salinity issues, fish entrainment, etc.

250. More recent data (particularly through 1998) are necessary to understand how the model represents a prolonged wet period (1995-1999 is the wettest 5 year period in the available historical hydrology).

251. CALSIM II does not handle the critical dry period well (e.g., 1977). SWPOCO is currently working with the Planning division to understand why CALSIM II over-estimates the drawdown of upstream reservoirs during this dry period.

252. For the more "traditional" planning activities, it is appropriate to use CALSIM II to perform "comparative" analyses; it is not appropriate to use the model in "absolute" mode. As the approach shifts from long-term strategic to short-term tactical planning, the analysis must shift from "comparative" to "absolute." However, with a good set of tools, one can still use the "comparative" mode to assess one alternative vs. another for short-term operational planning.

253. The current need for different software utilities for each input and links between sections of the model is cumbersome and prone to user error.

254. Run time is lengthy at 7 hours, in comparison to 15 minutes for CALSIM I. This is due to the additional operational scenarios captured in CALSIM II (e.g., D-1485, D-1641, (b)(2), joint point, and EWA), but it makes discovery and correction of input mistakes a long process. It often takes a week to get all the input data correct.

255. CALSIM I was more manageable; CALSIM II is harder to work with and a lot more involved in terms of understanding how it works and what is going on. The CALSIM II interface is more complex, especially with different "layers." CALSIM II takes weeks or months to learn.

256. CALSIM II is not good at predicting carryover deliveries and conveyance operations. CALSIM II's ability to realistically depict Article 21 water, Carryover deliveries, and conveyance operations can be improved by refining the assumptions and input used for the model.

257. There are problems with CALSIM II's representation of targets for carryover storage. CALSIM II draws Oroville down much further in the first dry year after a wet year than operators do in reality and operators are more aggressive about moving water from north of the Delta to the South in wetter year types than CALSIM II depicts.

258. CALSIM II cannot update predictions of deliveries to users based on changing monthly snowpack conditions, while operators do so in reality. For this reason, CALSIM II is not used for real-time operations.

259. CALSIM II operates and allocates water based on water year (October 1 through September 30); however, SWP allocates water based on calendar year, while the CVP allocates water from March 1 through February 28. The difference in water allocation period makes it difficult to compare between CALSIM II and the short-term operation plans.

260. The recent addition of the option to re-start a CALSIM II run at any month during the year, incorporating updated data on current conditions, is an improvement.

261. There are many specific operations that SWP undertakes during the year (i.e., carryover contract rights, Article 21 water) that CALSIM II cannot capture. These will be difficult to represent.

262. The assumptions that go into the final EWA layer of CALSIM II are crude in comparison to the fluidity of actual EWA actions, and so final results of CALSIM II do not reflect actual operations.

263. "How does one simulate the neuroses of operating decisions?" This is a difficult problem. Eventually, the model should allow operations to test operating rules.

264. CALSIM II is flexible enough to represent many things. But the problem is one of trying to simulate a moving target, such as with environmental requirements and the degree of aggressiveness in carryover operations.

265. CALSIM II results can be difficult to interpret and does not necessarily represent reality well.

266. CALSIM II results appear to be insensitive to changes in some inputs, especially annual requested deliveries.

267. Interpretation of results is more important than the results themselves. Now that many groups are using CALSIM II, there is concern that these interpretations may vary and conflict, especially when groups use CALSIM II in a stand-alone (rather than comparative) mode. The SWPOCO is comfortable using CALSIM II for long-term operations because it has staff capable of interpreting the model's output appropriately. When used without appropriate interpretation, the results could provide more "data" than "information."

268. The less information you have, the more conservative you are. With appropriate modifications, analyses performed with CALSIM II could help to reduce this uncertainty.

269. This group is fairly pro-CALSIM II because they have had good technical support.

270. "You gotta have tools. We want to see CALSIM II get better. It is a pretty useful tool in the right hands."

271. Planning models that are run on a monthly time step cannot consistently represent project operations because the standards to which projects are operated occur on a shorter time step.

272. DWRSIM and PROSIM were both "pure simulation" models. CALSIM II, on the other hand, is not a pure "simulation model"; it is an "interpreted policy" model. CALSIM II attempts to model policy decisions in addition to project operations. The approach of running the model for a single year four times to

represent the four distinct regulatory settings makes it much harder to interpret model results.

273. CALSIM II run time is too long. It is difficult to use CALSIM II for analyses requiring a quick turn-around time. PROSIM and DWRSIM ran in a few minutes, so that it was possible to perform several analyses in a short time. CALSIM II run time is absurd and beyond non-useful. One had better get it right at first, as it takes one whole day to do one run.

274. CALSIM II is an unwieldy model.

275. The solver is "buggy" for month-to-month analysis.

276. Current regulatory constraints cannot be implemented in a planning model. The biological assumptions incorporated in a planning model do not capture the adaptive nature of the process. It is not just the time step, but also the actual nature of the process. The biological assumptions that are modeled may or may not occur every year, but are modeled as if they do. It does not make sense that CALSIM II results should be used to make ESA jeopardy calls.

277. There is no guarantee that the system will behave the way CALSIM II simulates it, even if the same hydrology were to repeat itself. When the model is directly rule-based, such as PROSIM and DWRSIM, one could look at model results and see if they made sense. With an accounting/policy interpretation model such as CALSIM II, that is no longer possible. Under current regulatory conditions, the system cannot be simulated with a high degree of certainty.

278. The representation of the San Joaquin is weak in CALSIM II.

279. CALSIM II hydrology is inconsistent. Forecasted inflows are used in a few, but not all, basins.

280. What was wrong with FORTRAN code? Why should WRESL language be used?

281. The use of an LP solver is not a good idea for monthly simulations, as there are multiple optimal solutions. It is easy to get different solution for the same inputs. Model runs cannot be replicated.

282. WRESL language is hard to learn, but once learned it is easier than FORTRAN.

283. The setting of weights is arbitrary. It is hard to know whether "screwy" results are a consequence of poor coding or incorrect weight specification.

284. CALSIM II is in many ways more flexible than previous models.

285. The use of the ANN is an improvement over the MDO used in PROSIM.

286. Many parts of the model are better done in CALSIM II than they were in PROSIM and DWRSIM. However, the whole package is not, as CALSIM II is now so complex as to be unwieldy.

287. CALSIM II is beginning to address the emerging water transfer market in California it at the EWA level. However, much work is still needed in this area.

288. CALSIM II uses "magic water". Unless the mass balance is fixed CALSIM II cannot be used. The SWRCB now has to deal with the political repercussions of the Vernalis standards that were set too high because of "magic water" in DWRSIM. For the EWA runs, CALSIM II says there is either a willing seller or Yuba River water available. However, this water is not taken from anywhere to preserve mass-balance. This results in EWA runs showing benefits relative to less stringent constraints.

289. CALSIM II is a first-order model that feeds into second-order models. There is unchecked propagation of errors, particularly in a process such as Bulletin 160, when many models are used. Bulletin 160 provides an overly rosy picture of what can happen in the future.

290. Previous models were good training tools. Junior staff could come up to speed on how the system works by using earlier models. This is no longer the case. CALSIM II is such a complex model, it takes much "human investment" to understand it.

291. So much has been invested in CALSIM II. Will it ever provide the answers we want? Is there anything else that can be done?

292. Many improvements were made to the representation of the SWP system, but not to the representation of the CVP.

293. There is lack of output data organization in CALSIM II, as well as lack of direction within development staff at DWR

5) Can you identify specific CALSIM II support or development activities that would support your specific uses?

1. The inclusion of a physically based Delta model into CALSIM II. The model would need to be small enough to be computationally efficient, but sufficiently detailed to capture enough of the Delta relationships to be useful. For him, inclusion of the salient details of Delta relationships is more important than being computationally efficient.

2. Integration of CALSIM II with CVGSM (a distributed integrated hydrologic model) is the most important development activity. It is needed to estimate groundwater use and impacts.

3. A users' group is needed to overcome the impression that CALSIM II is a "closed shop."

4. Use of good version control and documentation software and procedures. There is a need for a "stable base". However, version control is as much institutional as software.

5. There should be some guidance of what makes a "good" study (i.e. what performance measures to use).

6. Model inputs should be restructured so that at least some are in a database (i.e., Access database) rather than text files. This also would allow better tracing of dependencies.

7. Sensitivity analysis with respect to hydrology and demands would be useful.

8. A finer spatial scale for CALSIM II should be considered.

9. Many of the items mentioned in #4 are being worked on.

10. CALSIM II would be more useful if it became a statewide model that included the Colorado River, for instance.

11. More model verification is needed.

12. CALSIM II would benefit from a better data management system.

13. Geographical user interface would be useful both for input and output presentation.

14. Hydrology data development is difficult and time-consuming, with a prohibitive turn-around time.

15. Groundwater operations in CALSIM II need further improvement.

16. Land use based demands for south of Delta should be incorporated to CALSIM II.

17. CALSIM II should have economic functions and/or ties to economic models.

18. Water use efficiencies should be incorporated in the development of water demands as input to CALSIM II.

19. The model has been asked to examine projects that have very complex operations (e.g. Sites Reservoir) affecting Sacramento River flows, diversions, EWA, changes in Delta water quality, and exports. CALSIM II is up against much bigger challenges than its predecessors

20. DWR is trying to evaluate which data and tools to use for future Bulletin-160 activities. This has implications for CALSIM II development.

21. A major change is occurring in water planning in California. Regional authorities are taking more responsibility and DWR must adapt its services for this change. A data clearinghouse function is useful for examining interaction and impacts of regional activities.

22. See above.

23. CALSIM II needs someone who can better tie modeling to operational policy and needs (George Barnes did this).

24. CALSIM II management is too defensive. This hurts the model credibility.

25. CALSIM II is not user-friendly. Developers need to talk to users about what they need and want in a model.

26. A users group would be a good way to spread the knowledge and understanding of CALSIM II to users outside the agencies.

27. A new hydrology set would be required to look a global warming.

28. There needs to be some kind of data management for all modeling data, not just CALSIM II, but a branch wide policy on data handling and management. Database should be fully documented and include metadata.

29. Output from CALSIM II cannot be identified from DSS pathnames.

30. DSS may no longer be appropriate because it cannot include metadata

31. He would like to expand the support base far beyond the agencies (DWR and USBR).

32. Stakeholders, consultants, research groups, and universities have taken hold of the code and have worked on improving various aspects of the model.

33. He would like to see a CALSIM II "development group" to identify issues, prioritize, and allocate resources for additional model development. All this would be possible if we "create a community".

34. Climate change studies.

35. Groundwater representation and data.

36. Improved graphic and output processing tools.

37. More informative output from the solver for debugging purposes.

38. More documentation on how to set up CALSIM II weight structure.

39. There is work under way to place all inputs and WRESL code in a relational database, and to include metadata.

40. Better presentation of output or a better post-processor would help. Currently, results require significant post-processing.

41. The agencies should spend some energy to educate CALSIM II users regarding what it does and does not do well so that people use it better.

42. There may be a need for a "more appropriate" operations forecasting tool, possibly an enhancement to the existing spreadsheet model. There may be a "void in the toolbox" here

43. Any modification of the CALSIM II model to make it applicable to the watershed level users would likely require assistance from DWR and USBR.

44. Development of GIS interaction for land use based demands and for the regulatory requirement layering.

45. Better representation of surface and groundwater interactions.

46. Implementation of a land-use model to determine demands based on rainfall cropping patterns.

47. It would be good to have more staff to run CALSIM II.

48. Not convinced that weekly time step benefits are worthwhile in terms of the effort required to develop the model and assumptions required to develop the input data.

49. Would like to have a "rigorous discussion" of the value of the work effort vs. value of product. The tendency to "drill down" on model details (e.g., calibration) compared to other approaches for estimating delivery reliability such as using stochastic inputs to CALSIM II. An issue would be how to communicate this more complex analysis to stakeholders.

50. Investment must be made on improving the hydrology and the allocation rules (see 4a, above)

51. CALSIM II needs to be modified so that it can be used in predictive mode. Most of the questions facing us today require a model that can provide absolute answers.

52. CALSIM II should reflect operators' decisions.

53. A sensitivity analysis of the assumptions used in the hydrology process is needed.

54. Implementation of hydropower accounting.

55. Better debugging capabilities.

56. Better documentation and version control

57. A review and documentation project that will reveal more about modeling rationale.

58. Development of a network schematic interface that will allow user to "point-and-click" on an object and see the time series, input data, etc. associated with it. It would help with resolving run time issues.

59. Removal of the bugs from the CALSIM software GUI.

60. Continue to develop and refine CALSIM II, such that it can be used in a predictive manner with fewer concerns about possible imprecision.

61. Improved demand modeling.

62. Improved groundwater surface water representation.

63. Smaller time step.

64. Inclusion of additional water quality stations in the Delta.

65. A daily time step. This is in progress in specific regions and basins.

66. Improved representation of the EWA and (b)(2).

67. Land use based hydrology and demands in the San Joaquin Valley (in progress).

68. Improved representation of the Stanislaus River (in progress).

69. The ability to incorporate water transfers into CALSIM II runs.

70. More skilled CALSIM II users. Hopefully this would result in greater competition for contracts to complete analyses that require CALSIM II.

71. Better debugging capabilities are needed.

72. Many procedures and processes have been instituted to keep track of CALSIM II development. Some have worked better than others.

73. All groups involved in CALSIM II development need to better document changes to CALSIM II between public releases. Better communication is needed, perhaps in the form of written bulletins, in addition to meetings.

74. Further development of the daily model

75. Creation of an interface between CALSIM II and other models that will reduce the likelihood of user error. Eventually modify CALSIM II so that it will directly create the input files for other models (such as CVPM or LCPSIM).

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will directly create the input files for other models (such as CVPM or LCPSIM).

77. On going developments of CALSIM II to better represent system operations for EWA, (b)(2), and water quality are warranted.

78. A daily time step version of CALSIM II needs to be developed for special applications like analysis of the Delta Wetlands project.

79. An "army of people" who know how to run CALSIM II would help. There are only so many knowledgeable people around. Given the need to conduct model runs, they cannot spare the people who are still working on model development. A backlog of studies needing CALSIM II runs has already built up.

80. A GUI or post-processing tool to make results more easily digestible. Currently everyone is developing their own tools and techniques for post-processing data, which results in use of the same model, but different post-processors.

81. DWR and USBR should continue to be responsive to criticism and input regarding CALSIM II. It is important to continue working on and improving CALSIM II. This will be a challenge given the demands for production work.

82. On going developments of CALSIM II to better represent system operation for EWA and (b)(2) operations are warranted.

83. A daily simulation capability would be appropriate for analysis of stream flows and Delta standards that have a shorter time step than monthly.

84. Calibration of the model to real-time operations.

85. A user group for agency (DWR and USBR) staff who run CALSIM II in association with various decision support activities could provide a forum for questions and answers between users of CALSIM II. This could take the form of a simple email list.

86. The ability to adjust CALSIM II's synthetic hydrology to reflect the current year's conditions would allow for a more realistic depiction of operations, especially later in the water year. However, it is recognized that such an undertaking would require an enormous effort by staff.

87. CALSIM II developers are now responsive to input from DWR operations staff; however, modifications based on their input take time and CALSIM II is being updated and re-released on an almost constant basis. There is a lot of pressure on CALSIM II modelers for many studies, but there is a good rapport between this group and the model developers. "CALSIM II has decent staffing and competent people, but there are many changes and each change takes weeks to make."

88. Daily time step.

89. Operating rules for other water quality constituents

90. Training of the ANN for major proposed structural or operational changes in the Delta. (An example would be the evaluation of something like an isolated facility which would change the flow salinity relationship).

91. Use of an efficient public domain solver, and elimination of the FORTRAN compiler would make CALSIM more accessible without the additional financial costs currently needed.

92. Enhancements to the input hydrology that are needed include: consumptive use model, better estimates of ET and soil characteristics, greater spatial discretization, and refinement of CVGSM for more localized applications.

93. It may be worthwhile to investigate the use of an alternative hydrology other than a specific (fixed) level of current or future development

94. CALSIM II should continue to use land use based demands (currently used in the Sacramento river basin, and will be used in the San Joaquin river basin for the 2030 and future hydrologies). A GIS approach will be an ideal tool to delineate agricultural and urban land boundaries and better represent land use especially with finer spatial discretization.

95. Refinement of spatial and temporal discretization.

96. For specific applications requiring use of CALSIM and other models, there has been a common problem of communication between the models. This is because the models were developed as stand-alones and by different groups under different circumstances. This problem needs to be addressed.

97. Taking full advantage of current and emerging technologies: for example training on the web for new CALSIM II users.

98. User would like to see the incorporation of a time element (e.g., dynamic demands that vary over time and in response to changing facilities) added to CALSIM II.

99. More recent

100. CALSIM II should be linked to a groundwater model for use in analysis that considers conjunctive use of surface and groundwater. The San Joaquin Basin has many over-drafted regions. Accurate simulation of recharge is important.

101. CALSIM II should be able to evaluate long-term impacts of water transfers on groundwater and groundwater levels.

102. Because of the nature of operating to B2 and EWA, periodic review of how B2 and EWA are implemented will be needed.

103. Efforts must be made to continue improving the hydrology.

104. An EWA workshop should be set up to refine that aspect of CALSIM II.

105. More training is needed on CALSIM II.

106. More cooperation between the agencies is needed.

107. Compared to DSM2, CALSIM II runs can be performed fairly quickly.

108. It is difficult to derive operating rules for the In-Delta storage facility, as there is not enough data.

109. The monthly time step may be too large for a number of projects. A daily time step would be more useful in a number of studies, particularly those requiring interaction with DSM2.

110. Any model can benefit from being enhanced either because of theoretical, technological, or applied considerations; it depends on the nature of the application and use of the results. As model purposes and applications change, the model needs to be continuously enhanced in addition to enhancements to better represent the system.

111. CALSIM II does a good job at representing the water resources system of the Central Valley (not including the Tulare Basin which is not modeled directly at this time), including hydrological and institutional constraints and representation of all the major projects. The long period of record allows for statistical analysis of impact of proposed projects when used in comparative mode.

112. Input data is at DSA level, which may be too coarse for some analyses. A lot of the data and parameters sets in estimating land-use based demands could be updated; e.g., rainfall data, crop evapotranspiration, number of crop categories, soil moisture characteristics, water demand efficiencies, etc.

113. A shorter time step is needed for many applications both because of institutional constraints and to better simulate the system.

114. Groundwater is modeled dynamically in CALSIM II, though at a DSA level. Current and future needs will require that the resolution and methodology used to account for the surface water and groundwater interactions be modified.

115. User support and documentation are very good, but can also be enhanced given the necessary resources.

116. The California water system is very extensive and complex. The complexity of CALSIM II only reflects the complexity of the system.

117. Land-use based demands in the San Joaquin valley will result in better simulations than the contract based demands currently in CALSIM II. (Note: The land-use based demands in the SJ valley will be included in the upcoming release of the 2030 hydrology).

118. CALSIM II's greatest weakness is its use of static demands.

119. This results in a loss of precision and detail in modeling results. Users models reflect changing infrastructure and demands over time; CALSIM II does not. As a result, the user must interpolate between CALSIM II runs reflecting different static levels of demand (e.g., 2005 and 2010) to develop a time-varied set of results to use as input for its own models.

120. It does not fully capture the "evolutionary path" of storage that realistically reflects the process of new facilities coming online. For example, as a reservoir is added to the system, its storage may increase for each of five years while it fills. CALSIM II cannot reflect this dynamic process.

121. It makes it difficult to look at the relationship between hydrology demands and water quality in the Delta over time.

122. CALSIM II's use of historic hydrologic sequences is a strength.

123. CALSIM II has a decent track record for calibration. This should be improved further, since yield numbers (e.g., quantity of water available to SWP contractors in a given year) sometimes differ between CALSIM II and DWR operations studies. This discrepancy may be due in part to CALSIM II's lack of a time element.

124. CALSIM II output is the limiting factor in users reliability studies because it only includes 1922-1995. CALSIM II should always include hydrology to within the past two years.

6) If CALSIM II were unavailable for your purposes, what would you use?

1. He would probably use some form of a sensitivity analysis. Apply a range of hydrologies to a Delta hydrodynamic model and then generate a response surface.

2. Would need to develop some other non-proprietary model. A non-proprietary model is needed to keep access and to keep the model up-to-date.

3. "Would have to invent it." Could not do planning studies without the ability to see how to evaluate impacts and benefits system-wide. Not aware of any other software able to perform this task.

4. For Bulletin-160 would do things in a more narrative and less quantitative fashion. Would talk to stakeholders to gather ideas to develop CALSIM III. We could not go back to just looking at "typical;" average and dry year water balances.

5. Would use DWRSIM and PROSIM, but these have not been maintained and kept up to date.

6. For DSM2 would use historical data.

7. Would use whatever DWR told us to use

8. DWRSIM or PROSIM can no longer be used. They are now outdated. Despite all CALSIM II weaknesses, it would be a "nightmare" without it.

9. DWRSIM

10. Would probably still be using PROSIM, or a new model based on MODSIM or Riverware.

11. Would like to be using a GIS based model (such as MIKEShe) that has an optimization engine, good visual output, and animation.

12. They would continue to use the current in-house simple spreadsheet models

13. PROSIM, or would be in the market for a new model.

14. Would use DWRSIM. Would have to use some kind of simulation model.

15. Would use PROSIM for CVP operations and DWRSIM for SWP and CALFED alternatives

16. PROSIM, STANMOD, SANJASM

17. Would either use PROSIM, or for simpler applications, spreadsheets. Would consider using Riverware. However, we would not have a rigorous model that adequately simulates both the CVP and the SWP.

18. PROSIM, with specialized spreadsheet models for enhancement.

19. Would develop a MODSIM based model.

20. ECOSIM

21. No other model is available for his purposes at this time

22. DWRSIM, but there really is no alternative model available.

23. DWRSIM and PROSIM.

24. PROSIM, with a great deal of post-processing, although this does not come close to representing (b)(2) or EWA and relies on outdated hydrologies.

25. Would use spreadsheet models for some applications.

26. Analyses would take longer than with CALSIM II and would rely more on educated guessing.

27. DWRSIM and PROSIM

28. Not sure. Perhaps a simple spreadsheet model, but would not be able to answer many questions.

29. Another model would be needed, CALSIM I, DWRSIM or the current operationsspreadsheet model. CALSIM II is not necessary for operations, but it helps to explain the risk and potential outcomes of possible choices and to defend decisions.

30. The SWPOCO would rely more on back-of-envelope calculations and smart, intuitive people. It has used, and hopes to continue to use CALSIM II to verify and test ideas and make innovations acceptable to stakeholders. It would be more difficult to convince stakeholders of the need and desirability of innovations without the model.

31. CALSIM II "has worked more in our favor." The model also helps inform contractors and EWA managers of how the system works and what is plausible.

32. As intuitive, experienced people retire or move on, there is a need to train new people fairly quickly, and models are useful for this.

33. The future will need to be less conservative with operations, and so will need to better assess risks. CLASIM II helps with this.

34. For a statewide planning study of CVP and SWP systems (and assuming that predecessors of CALSIM were unavailable also), the only model close to CALSIM for modeling the Central Valley inter-tied system for screening purposes is CALVIN. However, this will also depend on the application; hydrology and surface-ground water interaction not withstanding, CALVIN may still need to be modified to include many of the institutional constraints currently modeled in CALSIM but not CALVIN.

35. Short-term models exist and used by the O&M groups in both DWR and USBR.

36. User would build its own model, as it has to simulate its own local supplies and reservoirs

37. Build a new model, as there is nothing else available.

7) For your organization, who inside or outside your organization: (name and affiliation)

8) Who else should we talk with about CALSIM II?

9) Is there anything else you would like to add regarding CALSIM II?

1. Sometimes it's easy to forget what tools are out there, but eventually new studies and analyses will force him to learn more about CALSIM II.

2. There is a debate in the Bay-Delta office over the long-term purpose of CALSIM II. Some see CALSIM II as a model of the CVP/SWP system and are extremely cautious about any other uses. Others want CALSIM II to be a detailed model of at least the Central Valley, including local operations.

3. CALSIM II data collection is not well integrated into other offices within DWR. For example, CALSIM II development has not made use of the DPLA (Department of Planning and Local Assistance) expertise. There needs to be more willingness to open up the process, which will slow things down, but in the end it will produce a better product.

4. The culture within DWR was that program/project managers would get runs made by Sushil's group. Now program managers are much more involved in formulating, making, and interpreting runs, with review by the DWR modeling group.

5. There is a need to, at least, double the number of model users who can run the model.

6. The wider CALSIM II user community is a big step forward beyond DWRSIM, where very few people could run and interpret model results.

7. It is essential to achieve greater integration between the modeling and the planning groups. There is a need to break down the culture dividing the modelers from planners.

8. Overall, feels bad about the controversy surrounding CALSIM II. There is no management oversight of the model at a level higher than Francis at DWR or at USBR. There have been no modelers at higher management level since Kennedy and Potter left.

9. Model developers could have had a better product if they had talked to people earlier in the development process. Unfortunately, some DWR folks have been hostile to input and or comments from outsiders. Frustrated at the lost opportunity. Making the model an issue is a strategic mistake for DWR. Less time should be spent defending the model, as it only serves to hurt the model credibility.

10. Much of CALSIM II is improving. Things that needed to get fixed are being fixed. CALSIM II will get there; it is just a matter of time.

11. No

12. DWR should work more like a clearinghouse than a sole developer. CALSIM II development should be decentralized so that talent and resources that exist across the state can be tapped.

13. created and implemented.

14. A free multiple-integer LP solver.

15. No

16. There is confusion between CALSIM (the software), and CALSIM II (the model of the CVP/SWP system).

17. Very few people outside DWR and Reclamation take advantage of the bi-weekly coordination meetings.

18. Despite limited knowledge of CALSIM II, it still seems to be a great tool and model. It (or something like it) is needed in California to bring local information to the state level.

19. In general, models need to be as simple as possible so that the average user can understand and use the model with confidence. The most important thing for a model is that the user needs to have confidence in the model and its results. In other words, the model needs to be "user-friendly."

20. Hopefully CALSIM II will eventually be used in the Bulletin 160 process.

21. Amazed at the culture that has developed around CALSIM II. Training people outside of DWR and communicating what CALSIM II does and the value of the results requires management. These "public outreach" efforts are an important component to DWR's computer simulation programs…in addition to conducting model runs and developing the models.

22. There is a weakness in the way CALSIM II is formulated. CALSIM II is a policy model that is used to simulate the entire system, physical as well as regulatory/policy constraints. CALSIM II formulation is based on DWRSIM formulation. There was not much thought into what questions CALSIM should be able to answer. What is needed is a watershed model that captures the physical aspects of the system (hydrology), which would then feed into a policy model containing the policies and regulatory constraints. The ideal model would start with water supply forecast so that informed operation decisions can be made.

23. Previous models were used extensively, including in the support of court decision. We were used to them and knew their strengths, weaknesses, and limitations. That understanding will take a while to develop with CALSIM II. In the meantime we need to spend much time explaining CALSIM II results to clients.

24. No.

25. CALSIM is very complex (as compared to PROSIM and other early models) due to the comprehensive treatment of the State Water Project and the Central Valley Project, and due to more advanced technology. Ten years ago one developer could just about keep up with PROSIM development. Now many are contributing simultaneously. Version control must be addressed much more rigorously. Quality control is more difficult because it is not possible

for an individual to understand all aspects in detail. The political environment that CALSIM must be applied to is much more complex. This technical and political complexity act in concert to require a complex management.

26. I see the management evolving from a single person effort, jumping over the idea of a supervisor leading a team of modelers, to CALSIM management that requires a lead, looking at broad issues, who is over the supervisor and technical modeling team. This management model seems to be in place at DWR but not at Reclamation.

27. No.

28. Fortunately, I have really liked working on this model. It has been both interesting and challenging, and the people that are working on it are very good.

29. CALSIM II really is a joint model in the way the model is being used. Technicians on both agencies have confidence in CALSIM II. There are and there will always be valid criticisms, and we will keep working on improving the model. On a technical level, CALSIM II creates a level playing field for the agencies.

30. "As with any model, we need to be cautious of not putting too many features into CALSIM II." CALSIM II is quickly becoming too complex for most users and applications. If all the features are necessary, then two versions of the model should be maintained; a high end and a low end product. The low end product would allow for quick, gross analyses, while the high end would allow for more sophisticated detailed analyses.

31. We are very happy with the CALSIM II model. There has been much pressure to perform these studies in a short time frame. CALSIM II has worked well for us. In terms of accuracy and uncertainties, CALSIM II is better than DWRSIM.

32. He is really impressed with the work that has been done to this point, especially the addition of the optimization language into CALSIM.

33. CALSIM II is the best available tool for evaluating California's very large and complex water supply system.

34. CALSIM II is the best available tool for evaluating California's very large and complex water supply system. There is no other comparable model out there that can be used for the types of analyses that are needed for the storage investigations.

35. CALSIM II is a good model. A users group is needed to facilitate appropriate use and understanding, and to informally talk about common problems and solutions. Unresolved issues can be brought to CALSIM II developers. There

is only so much DWR can do. Confidence would improve if people share problems and successes.

36. No.

37. No.

38. CALSIM II is an excellent tool for performing statewide studies and for comparing alternatives. Any model can be enhanced and CALSIM is no exception; it depends on the nature of the application and use of the results. As model purposes and applications change, the model needs to be continuously enhanced both from the engine perspective and the application. CALSIM II is an efficient and flexible model of the CVP/SWP systems and is available to the public (both generic form and application to the CVP/SWP system). CALSIM II is versatile enough that it can accommodate

39. hydrology (including up to the past two years) should be added to CALSIM II.

40. User is currently leveraging CALSIM II to the maximum possible extent. User will continue to do so and hopes that CALSIM II will continue to improve and allow for further leverage.

41. CALSIM II is a failure. It does not represent reality.

42. It is not clear if the questions being asked can ever be answered with a long-term planning model. No tool can currently address all the issues in water policy. It is an overwhelming data and analysis problem.

APPENDIX H: REFERENCE MATERIALS

Dennis O'Connor, "Comments on the Department of Water Resources' Draft State Water Project Supply Reliability Report," California Research Bureau, Sacramento, CA, 15 pp, plus 10 charts, November 1, 2002

Spreck Rosekrans, collection of email and written correspondence from 1991 to 2003 from Environmental Defense to DWR concerning DWRSIM and CALSIM II issues.

Robert C. Wilkinson, "Comments on DWR's Draft Report 'The State Water Project Delivery Reliability Report'," letter to Thomas Hannigan, Director of DWR, 5 pages, October 31, 2002.

Deven Upadhyay, "DWR Modeling Related To Bulletin 160: Comments/Issues," undated comments, 2 pages.